



# The Solar and Heliospheric Observatory

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**SOHO is a mission of international cooperation between the European Space Agency (ESA) and the National Aeronautics and Space Administration (NASA)**





## **SOHO OVERVIEW:**

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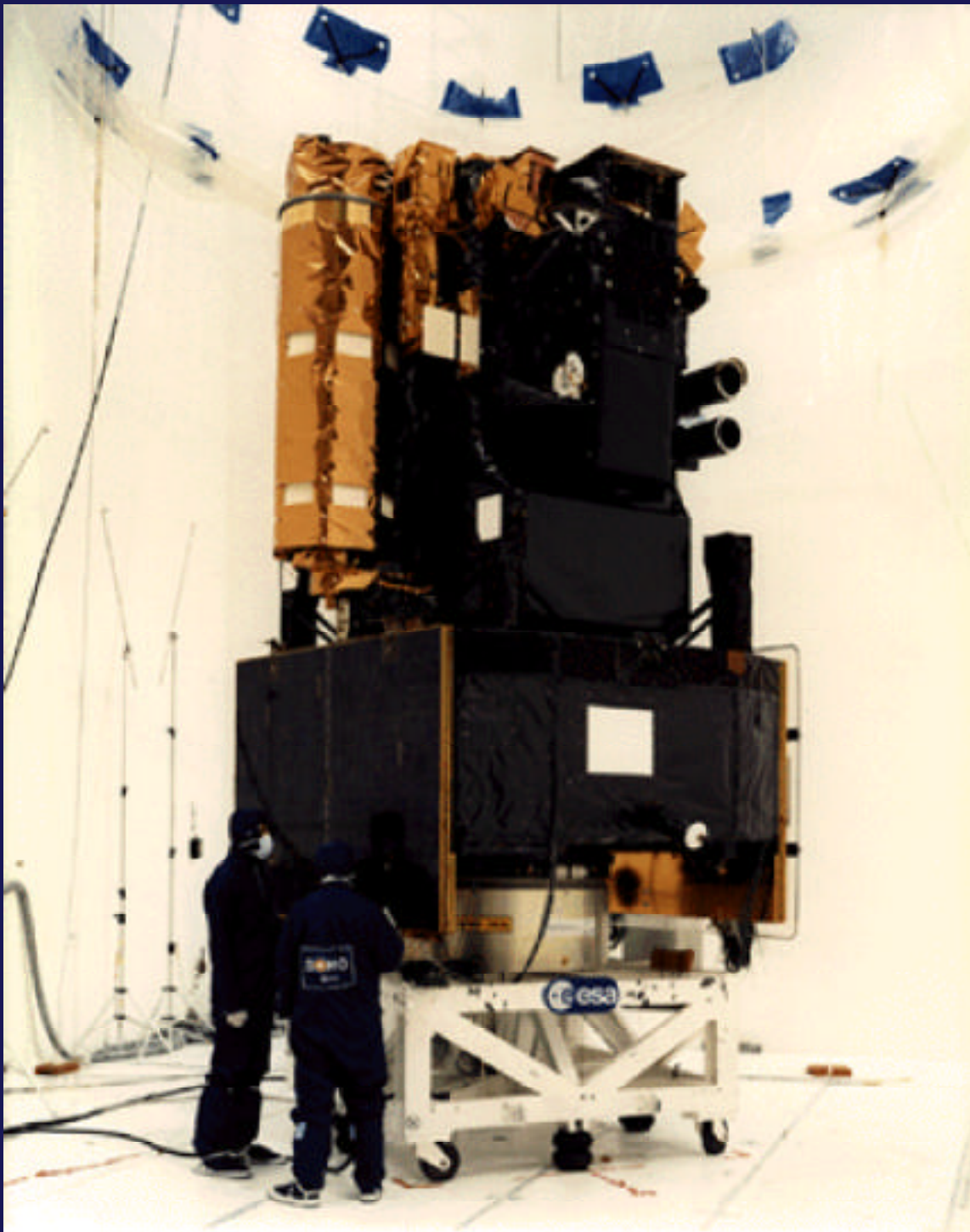
- **JOINT EFFORT OF ESA AND NASA**
- **LAUNCHED ON 2 DECEMBER, 1995**
- **IN ORBIT ABOUT 1.5 MILLION KILOMETERS SUNWARD OF EARTH**
- **HAS 12 COMPLEMENTARY INSTRUMENTS TO STUDY THE SUN'S INTERIOR, ATMOSPHERE, AND SOLAR WIND**
- **OPERATIONS LOCATED AT NASA'S GODDARD SPACE FLIGHT CENTER, MARYLAND**



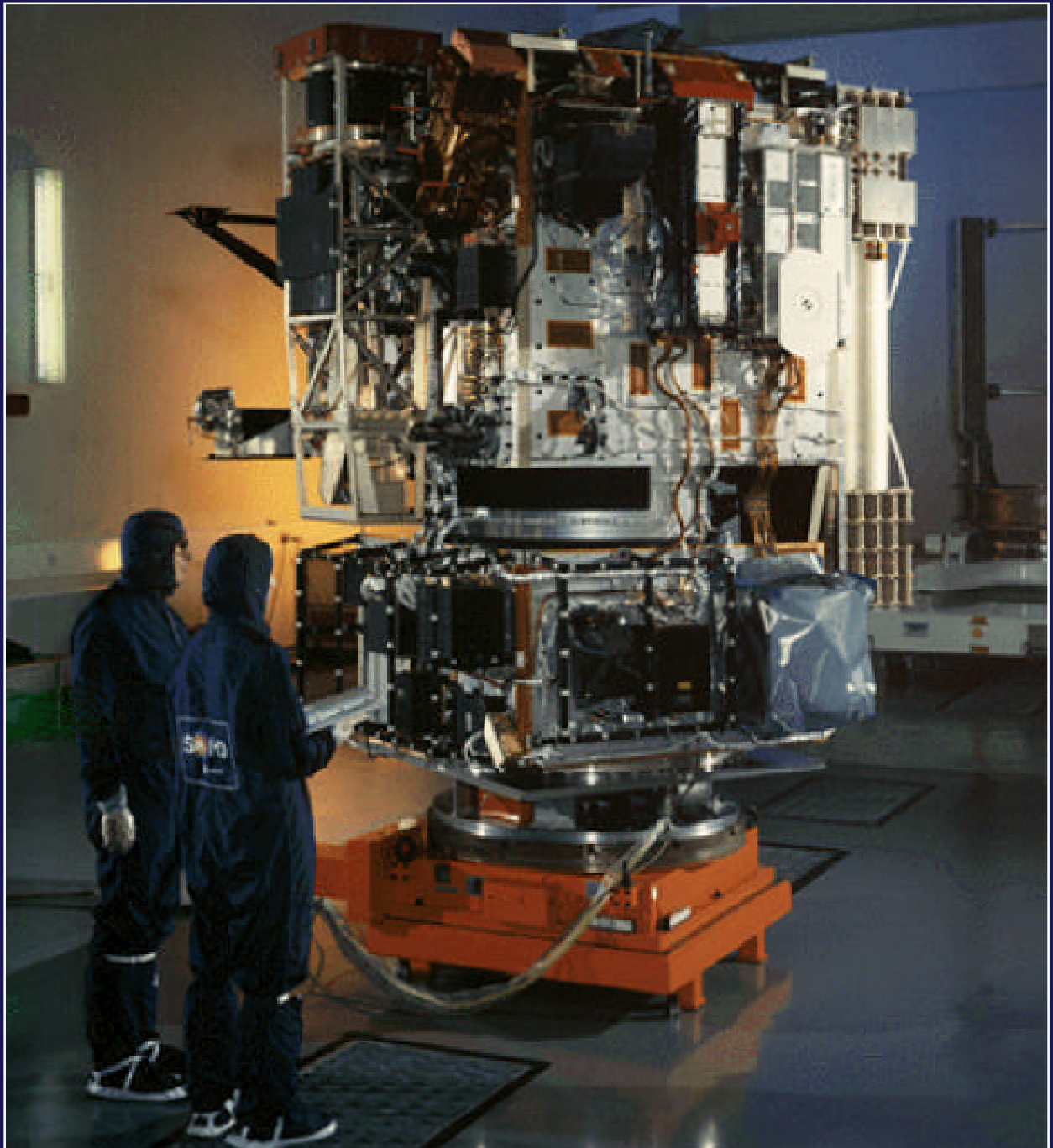
## **SOHO SCIENTIFIC OBJECTIVES:**

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- **STUDY THE STRUCTURE AND DYNAMICS OF THE SOLAR INTERIOR**
- **STUDY HEATING MECHANISMS OF THE SOLAR CORONA**
- **INVESTIGATE THE SOLAR WIND AND ITS ACCELERATION PROCESSES**

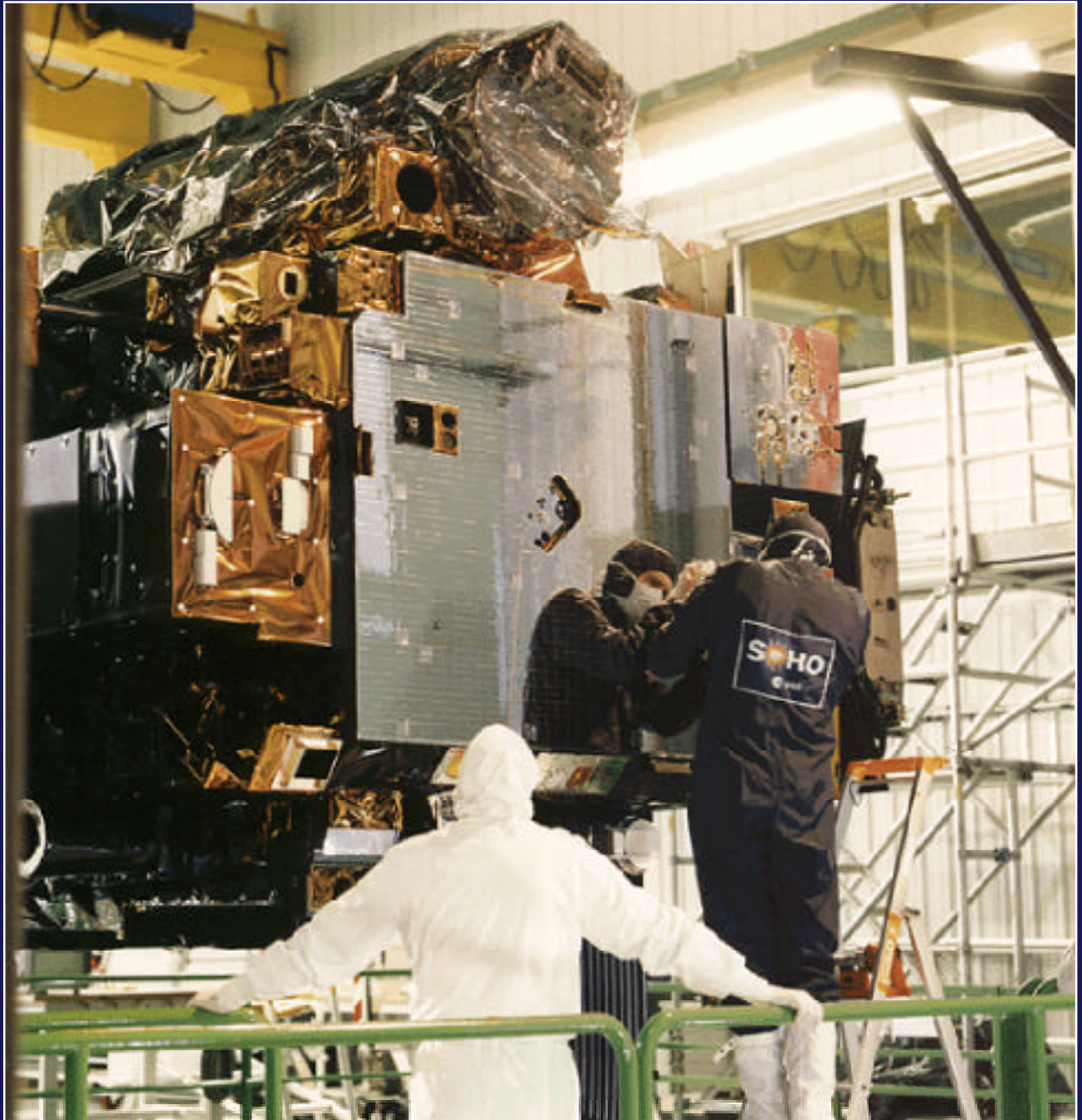


**The SOHO spacecraft in launch configuration prior to acoustic tests at Intespace in Toulouse, France.**



**SOHO payload module, without thermal blankets,  
at the end of its integration and testing at  
Matra Marconi Space**

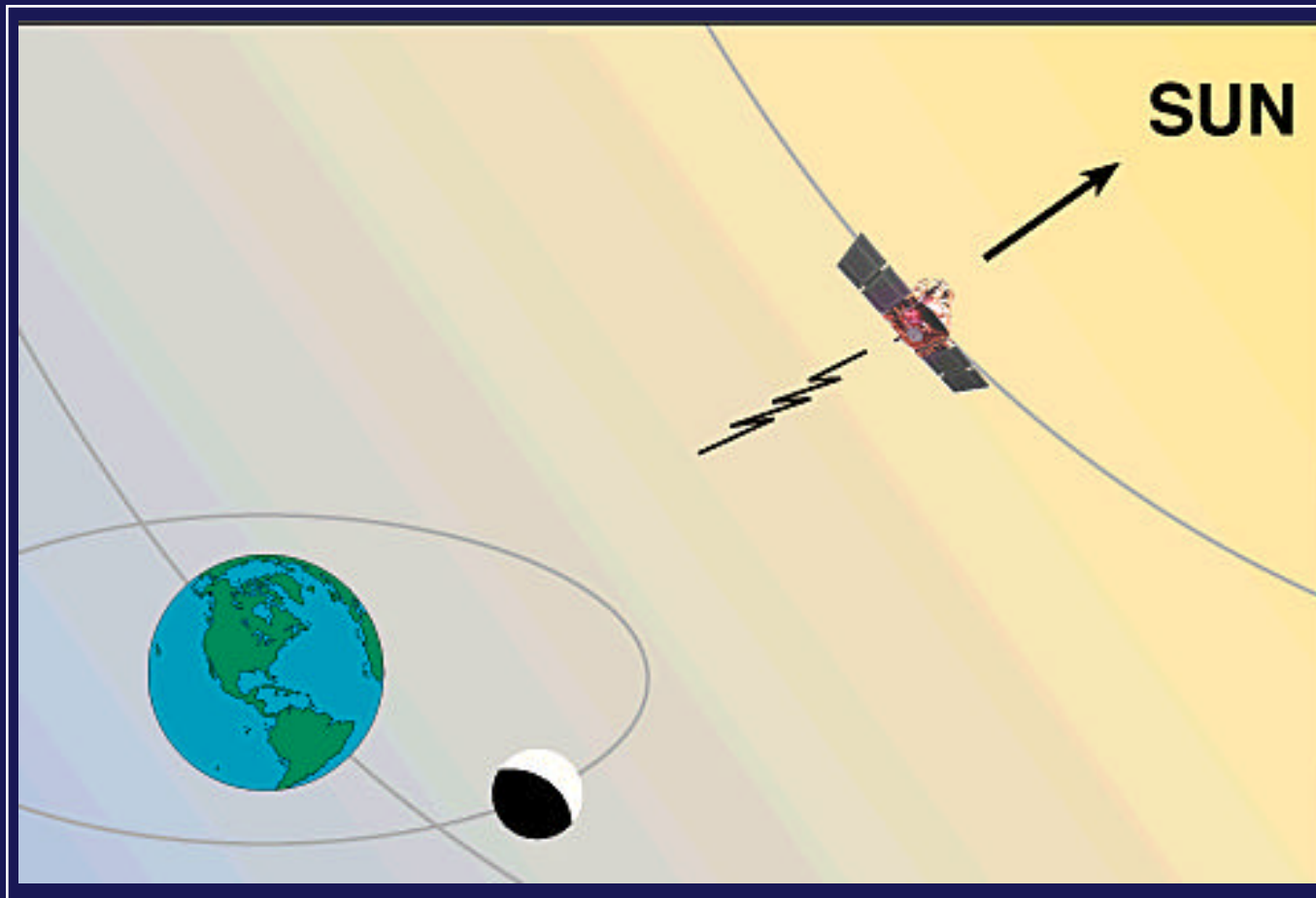




**SOHO spacecraft nearing the end of assembly**

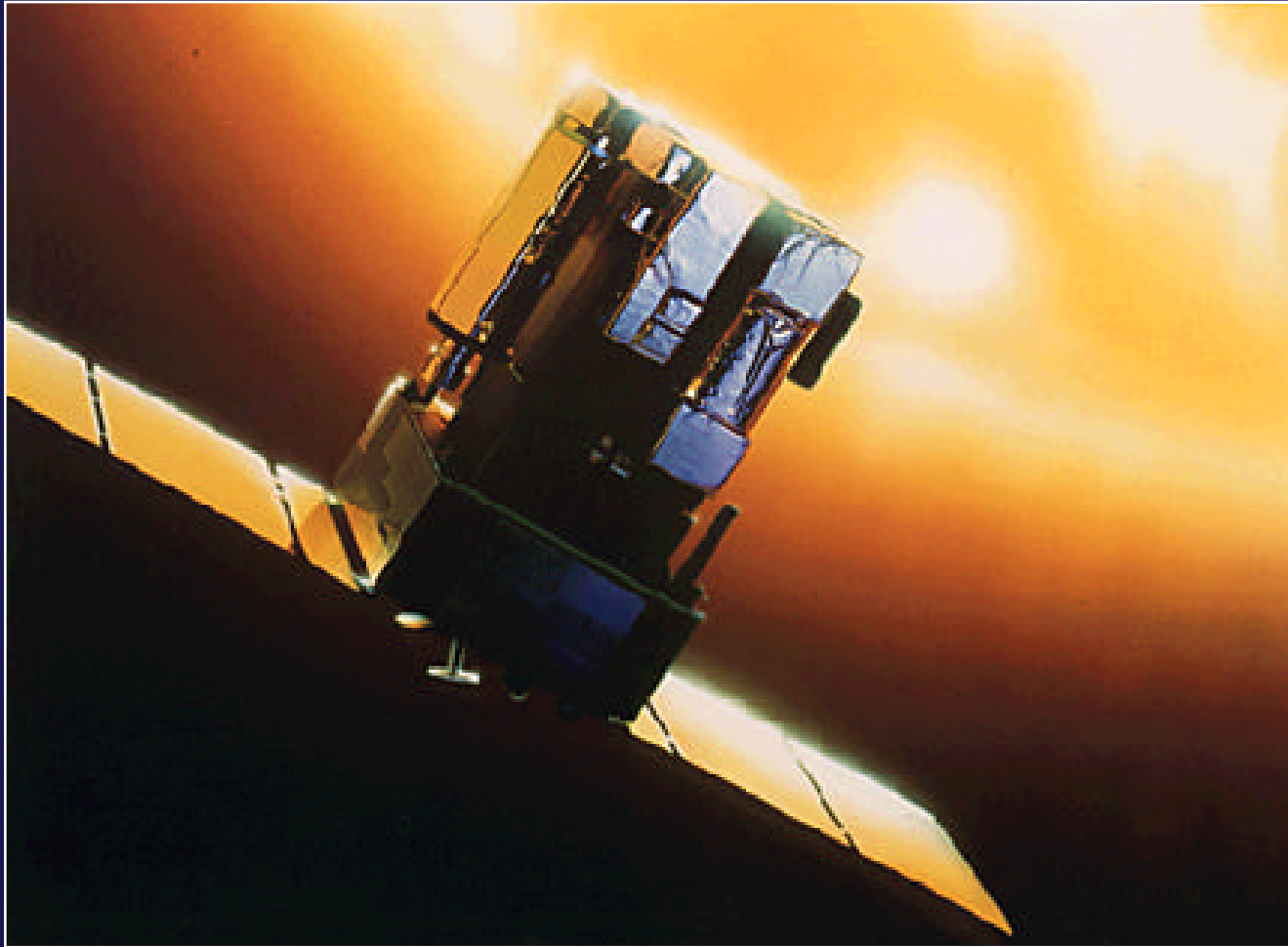


**SOHO being prepared for launch by an  
Atlas-Centaur rocket on 2 December 1995**

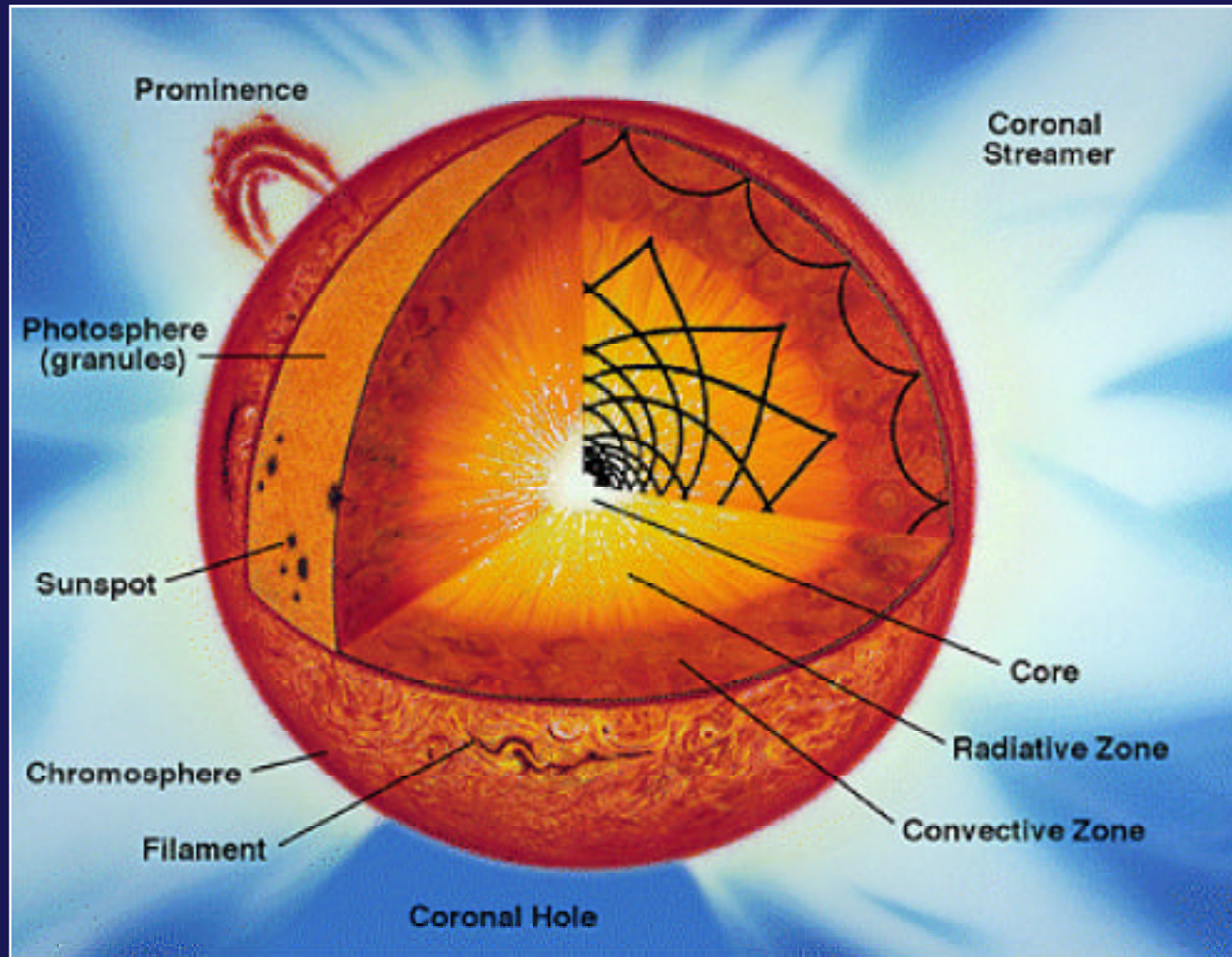


**Schematic of SOHO's orbital path in relation to the Earth, moon, and Sun – SOHO is about 1.5M km sunward of the Earth**





**Artist's rendition of the SOHO spacecraft**



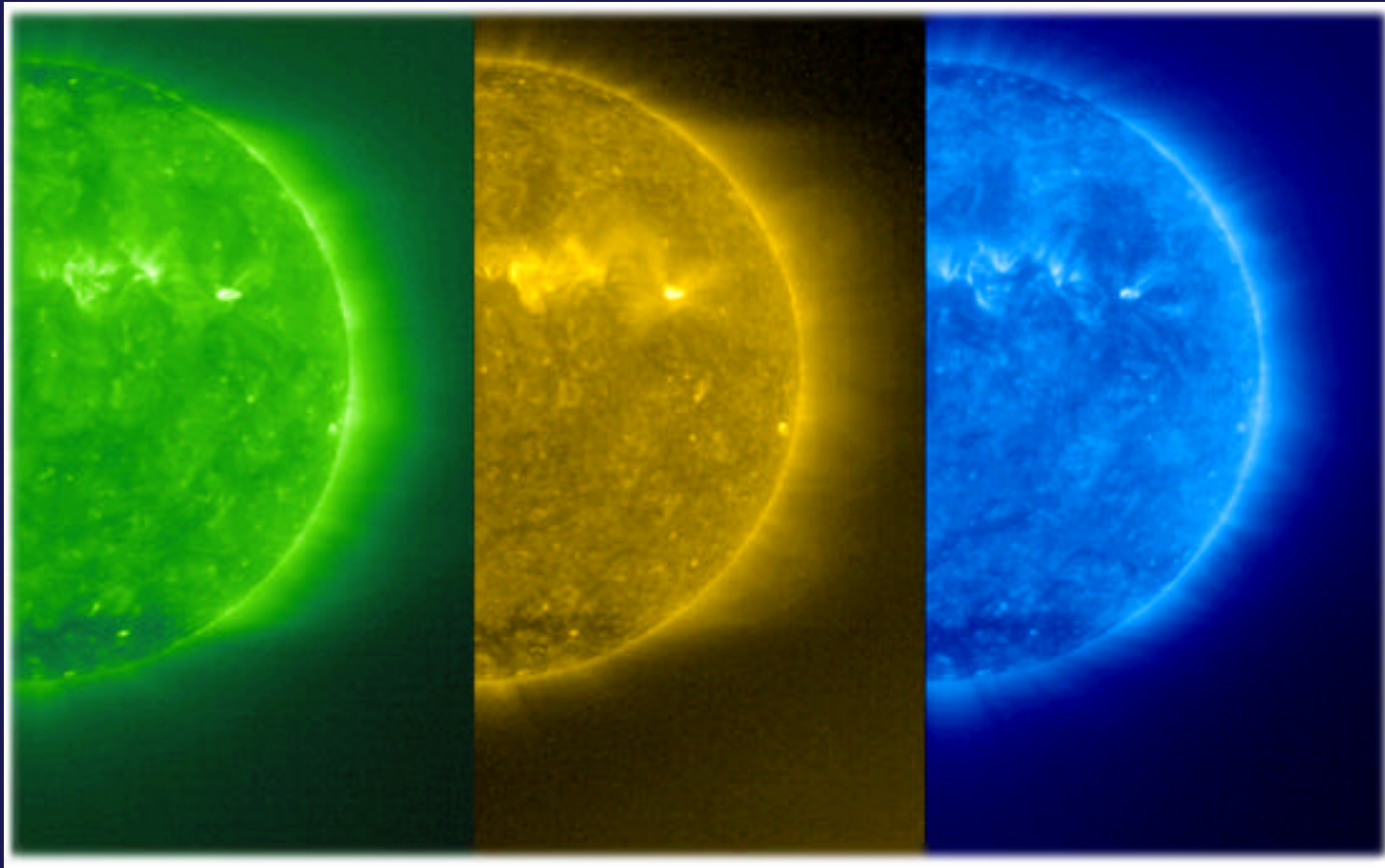
**The Sun, our star**



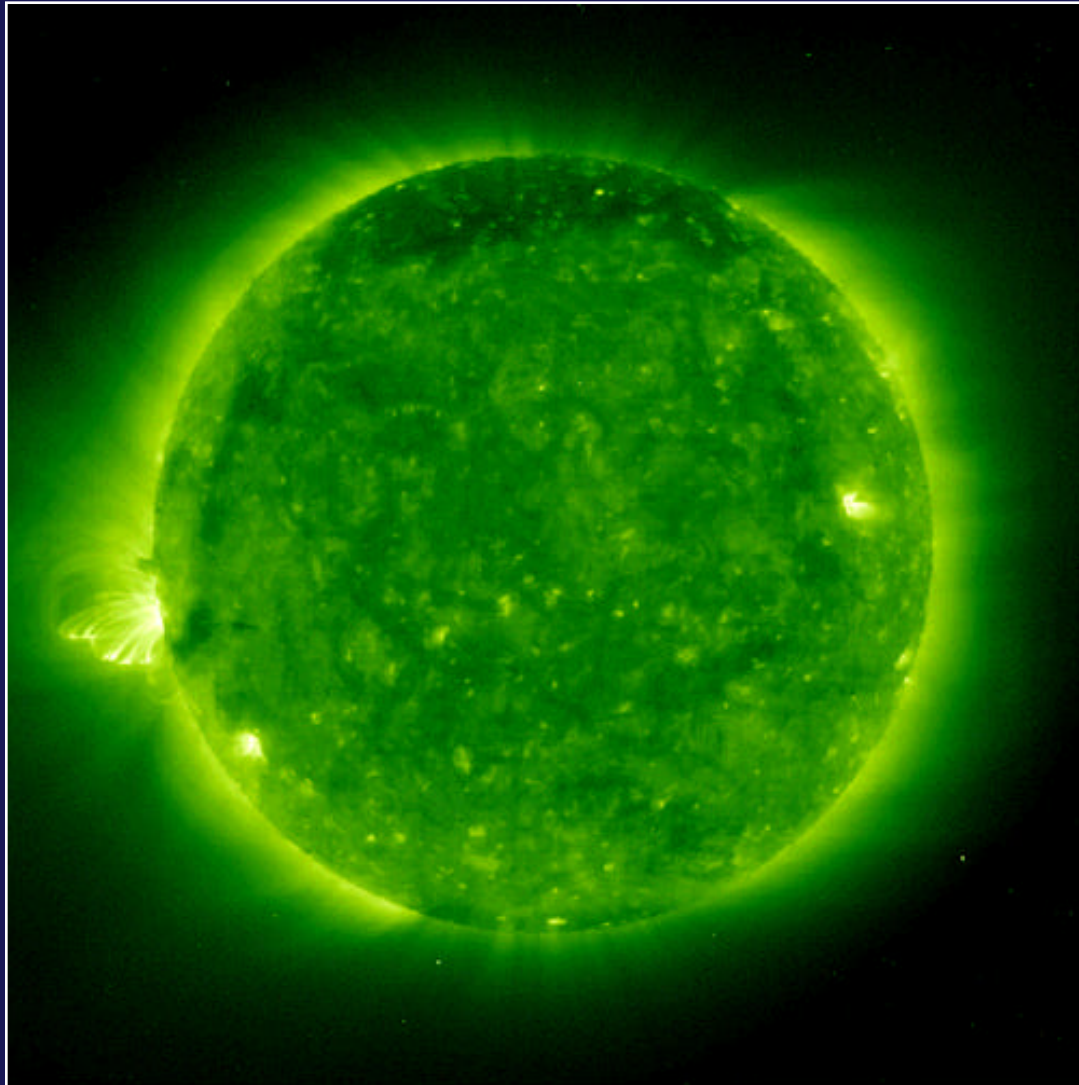
Fe XII 195Å (1.5M K)

Fe XV 284Å (2M K)

Fe IX/X 171Å (1M K)

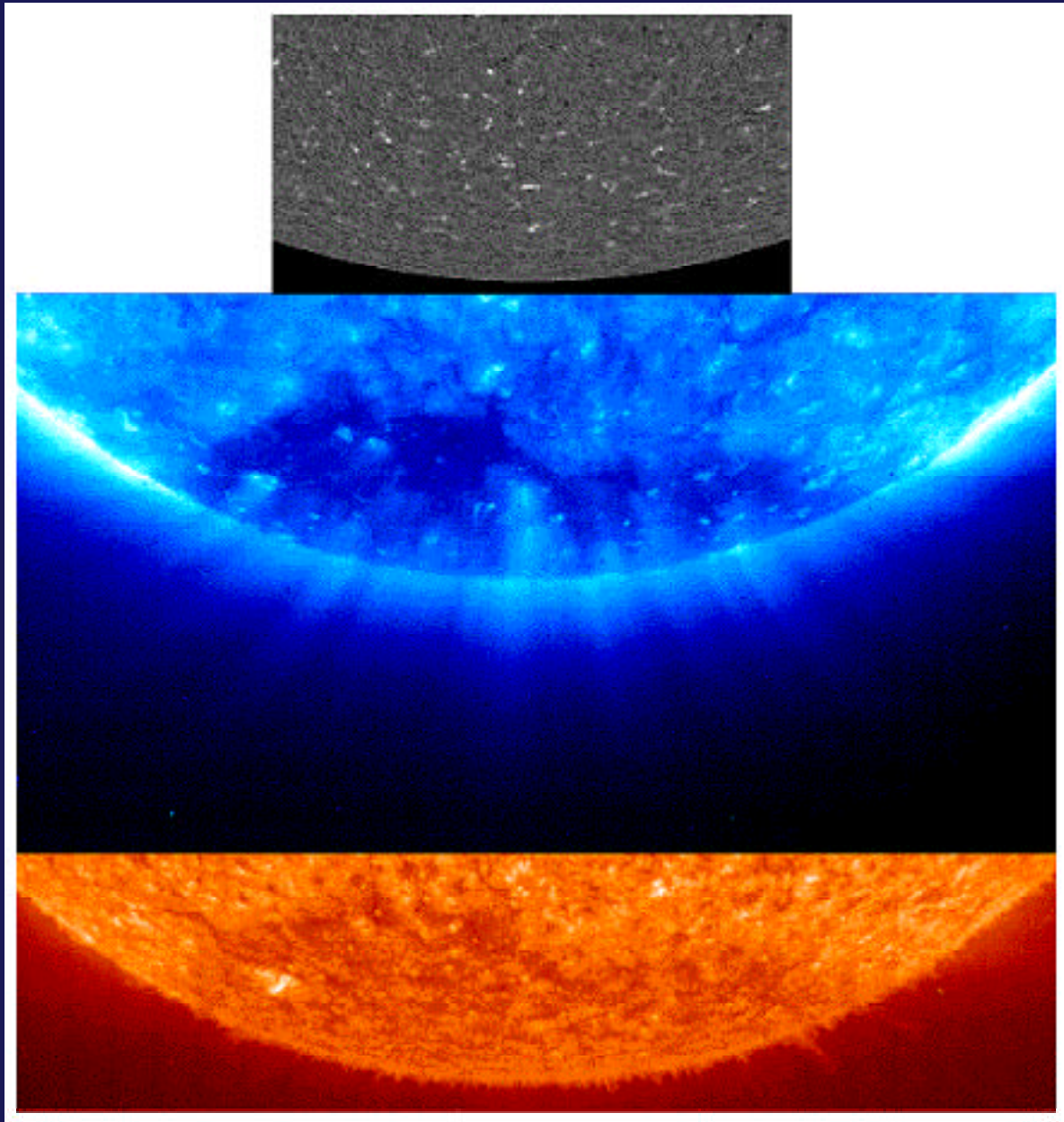


**Composite of three Extreme ultraviolet Imaging Telescope (EIT) images taken on the same day at different wavelengths**



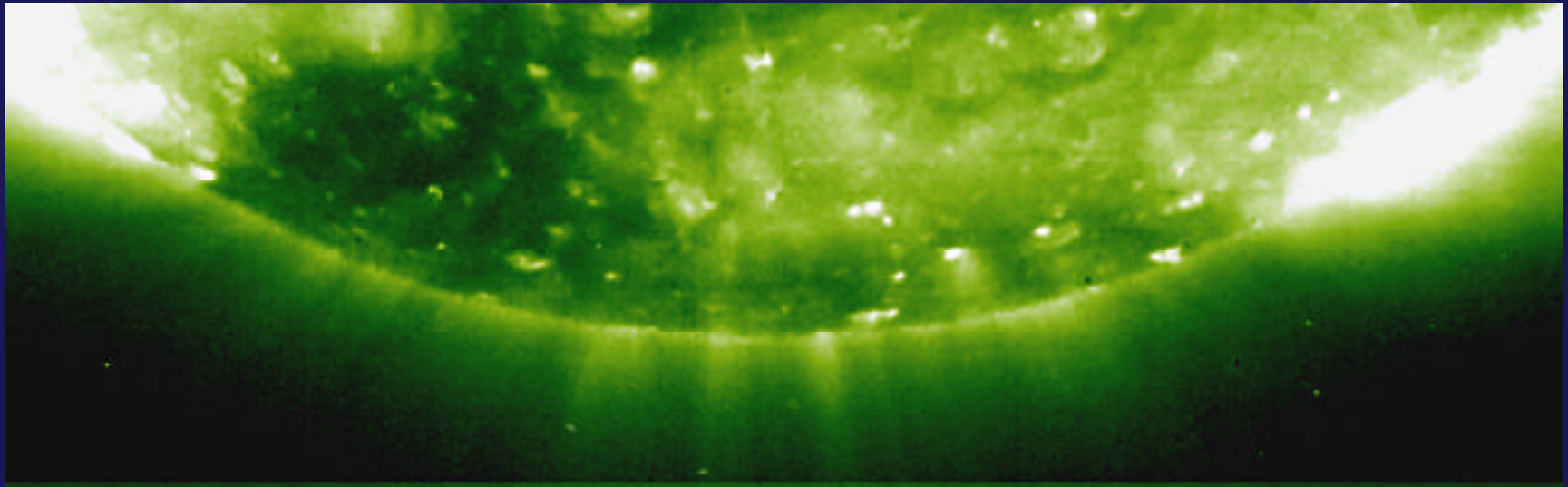
**EIT full sun image**  
in the Fe XII emission line at 195 Å showing the corona  
at a temperature of about 1.5 million K





## Polar Plumes

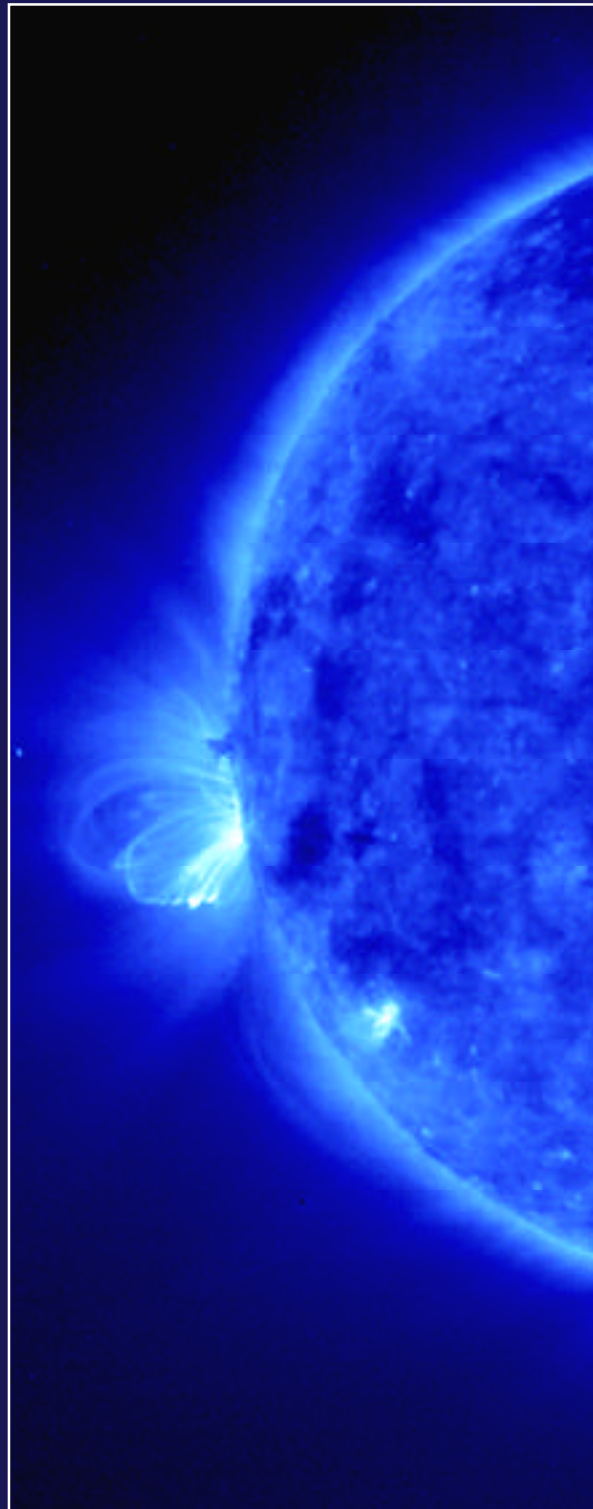
Top to bottom:  
MDI magnetogram  
EIT Fe IX/X 171 Å  
EIT He II 304 Å



**EIT close-up of plumes in a polar coronal hole**  
(Fe IX/X emission lines at 171 Å)

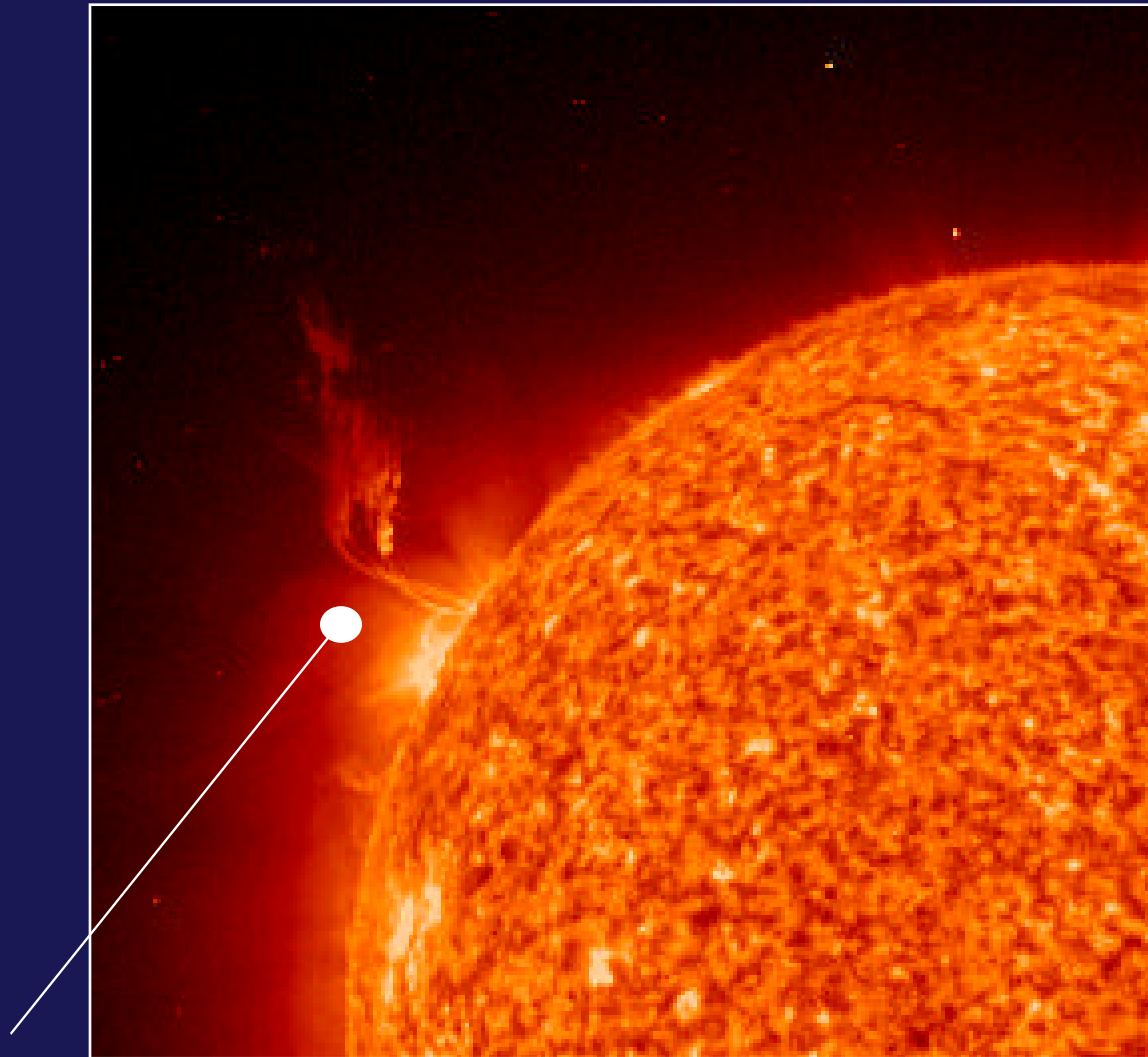


**EIT full sun image**  
in the He II emission line at 304 Å showing the upper chromosphere/  
lower transition region at a temperature of about 60,000 K

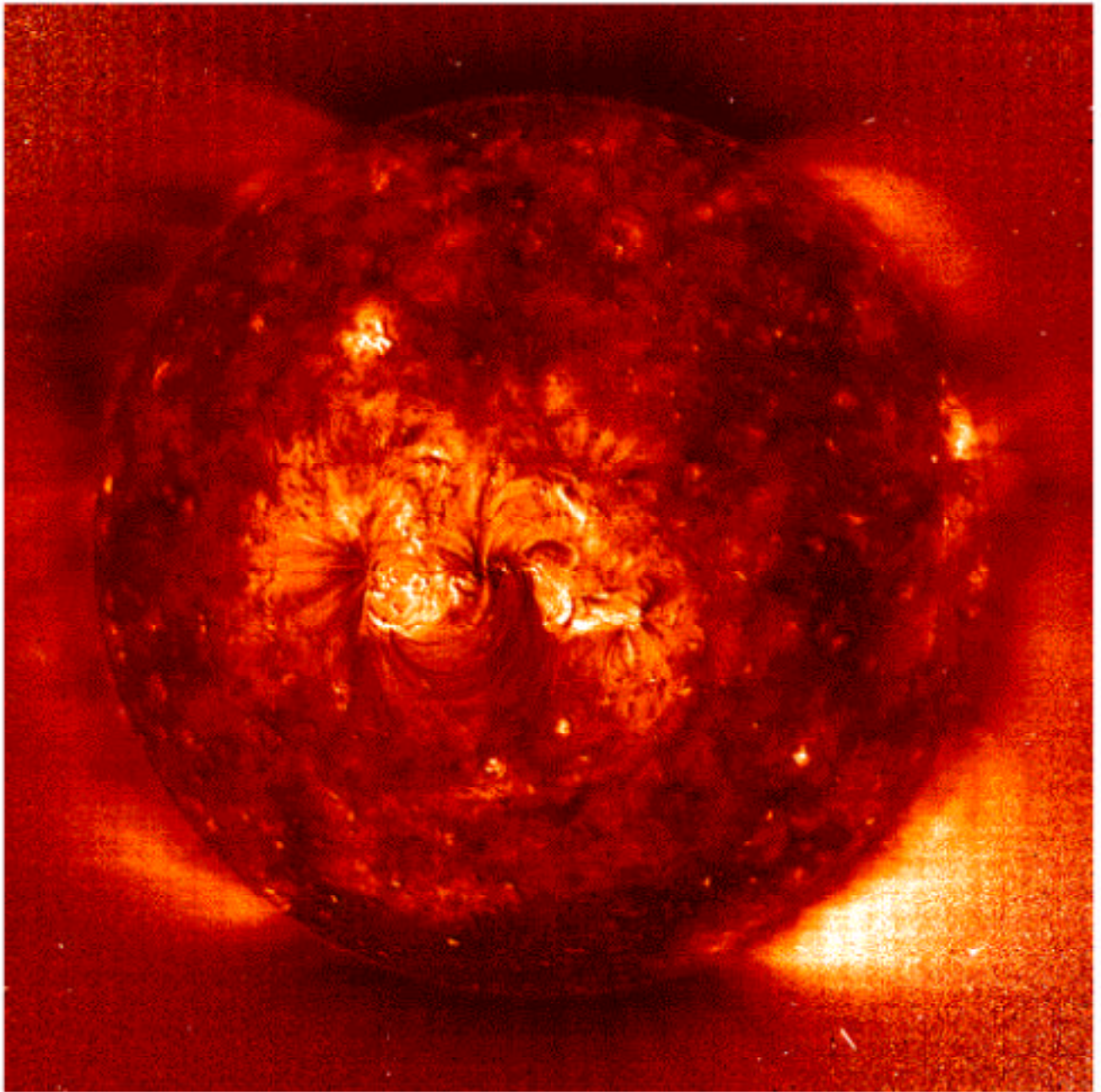


**Post flare magnetic loops as recorded by EIT  
in Fe IX/X at 171 Å. The fully ionized plasma,  
at temperatures of 1 million K, gradually  
cools down after the flare.**

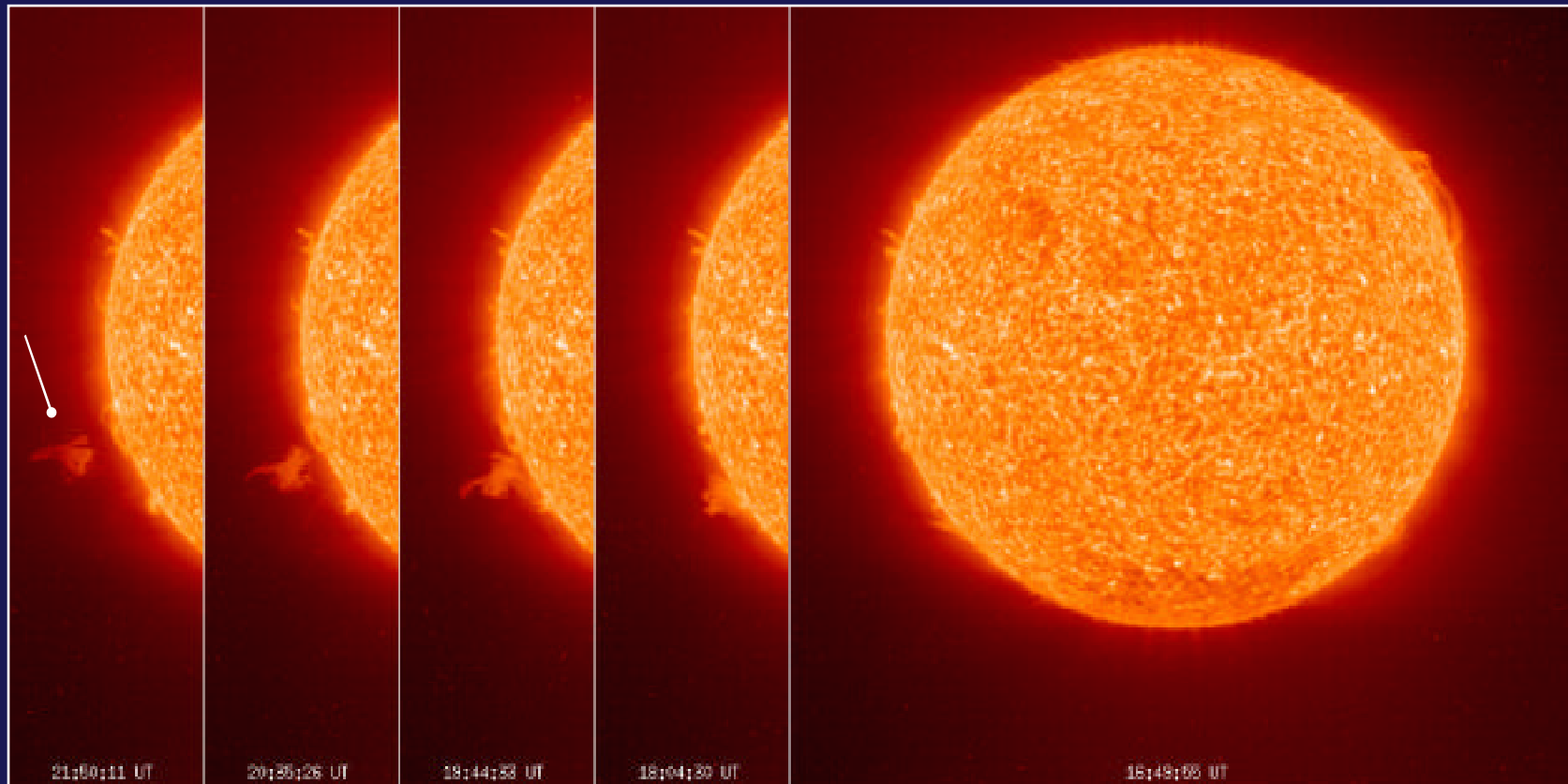




**Prominence eruption observed by EIT in He II  
304Å on 23 February 1997**



**Ratio of EIT full Sun images in  
Fe XII 195Å to Fe IX/X 171Å – Bright  
areas are hotter; dark areas are cooler**

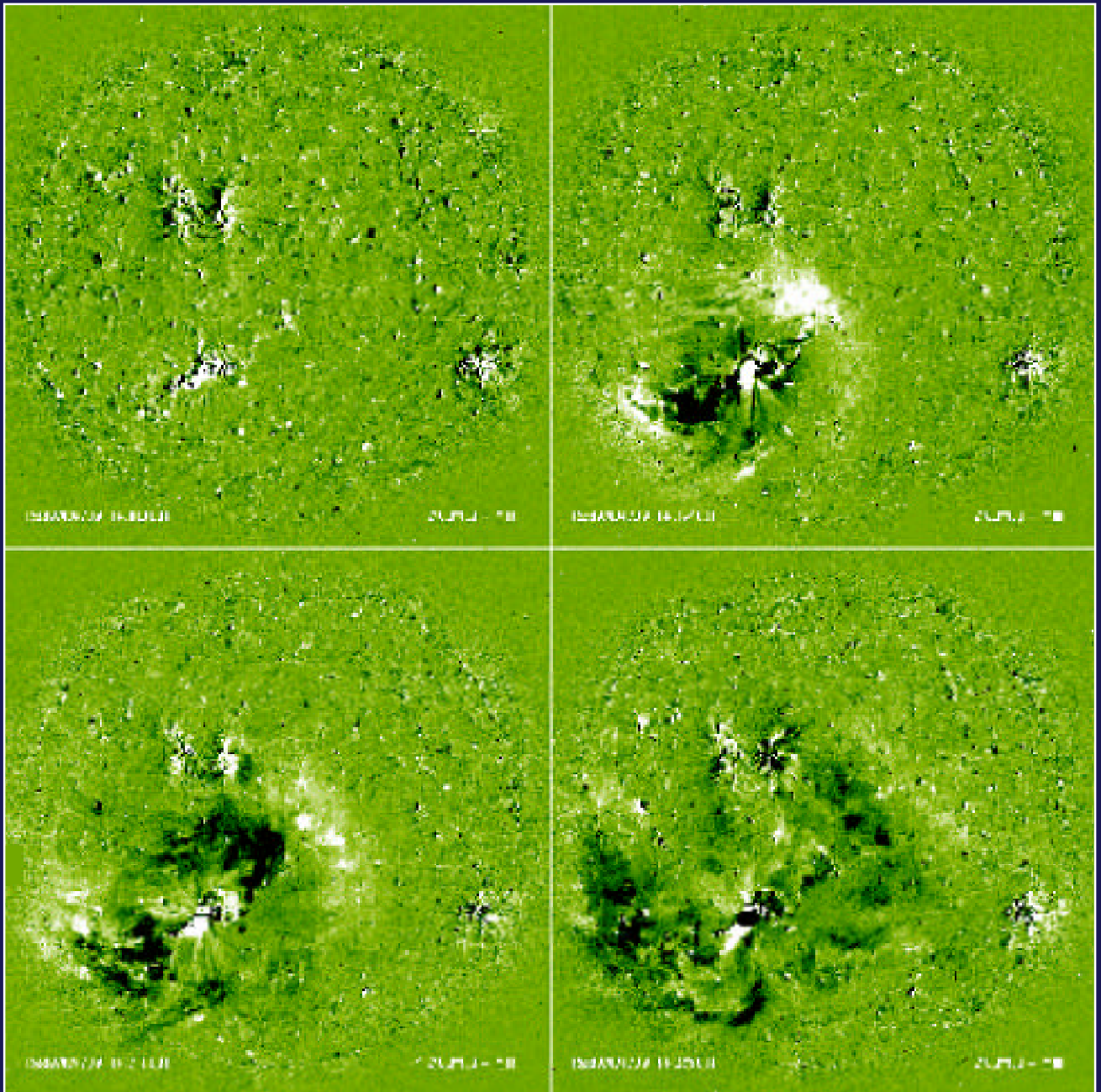


**EIT sequence in He II 304Å showing a blob of 60,000-degree K plasma, over 120,000 km long, being ejected at more than 15,000 km/h**

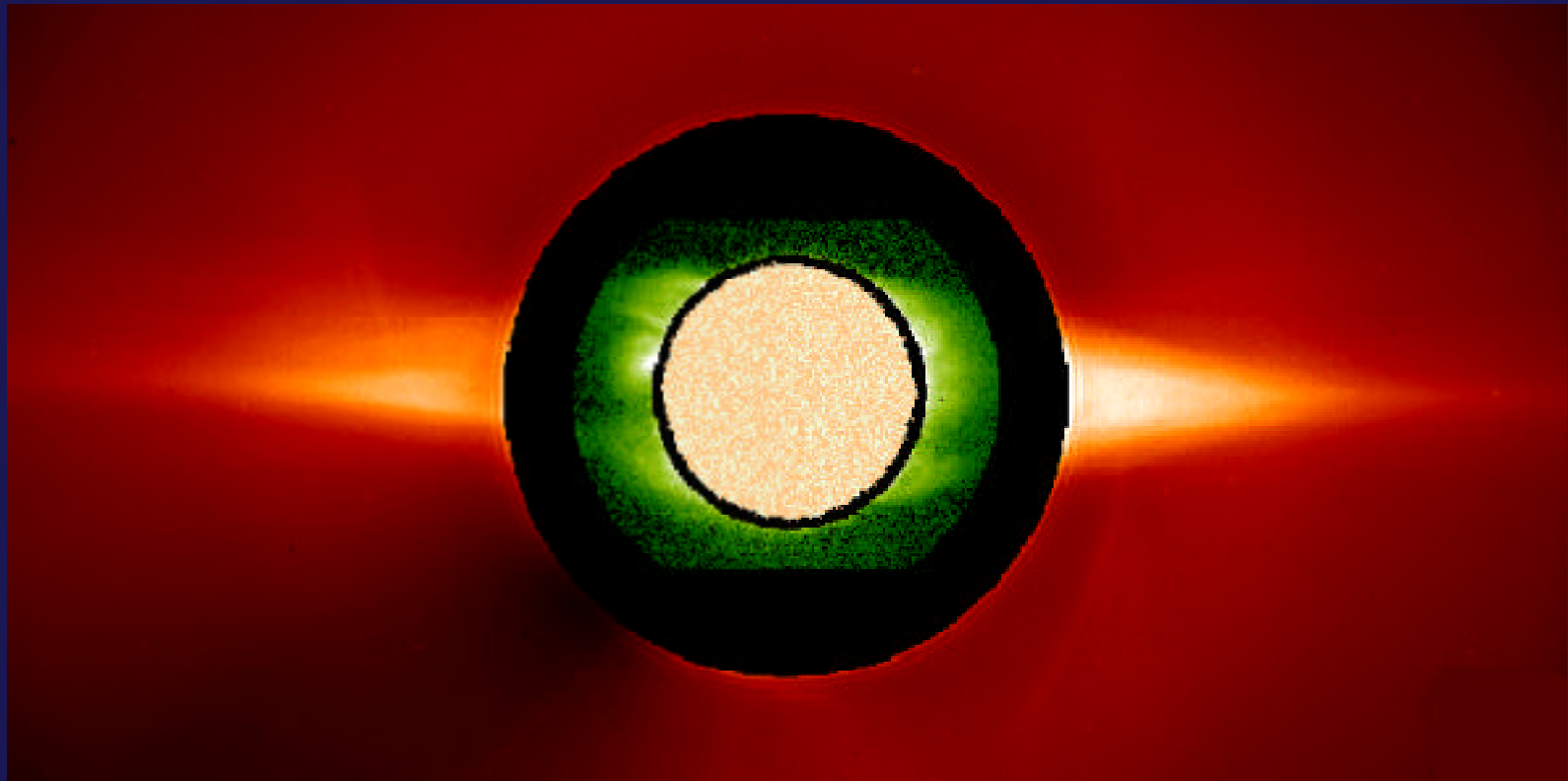


**UVCS/EIT composite ultraviolet image**  
of the Sun's extended corona as recorded by UVCS in the light of  
O VI at 1032 Å (outside black circle), and by  
EIT in Fe XV at 284 Å (inside circle) on 22 August 1996





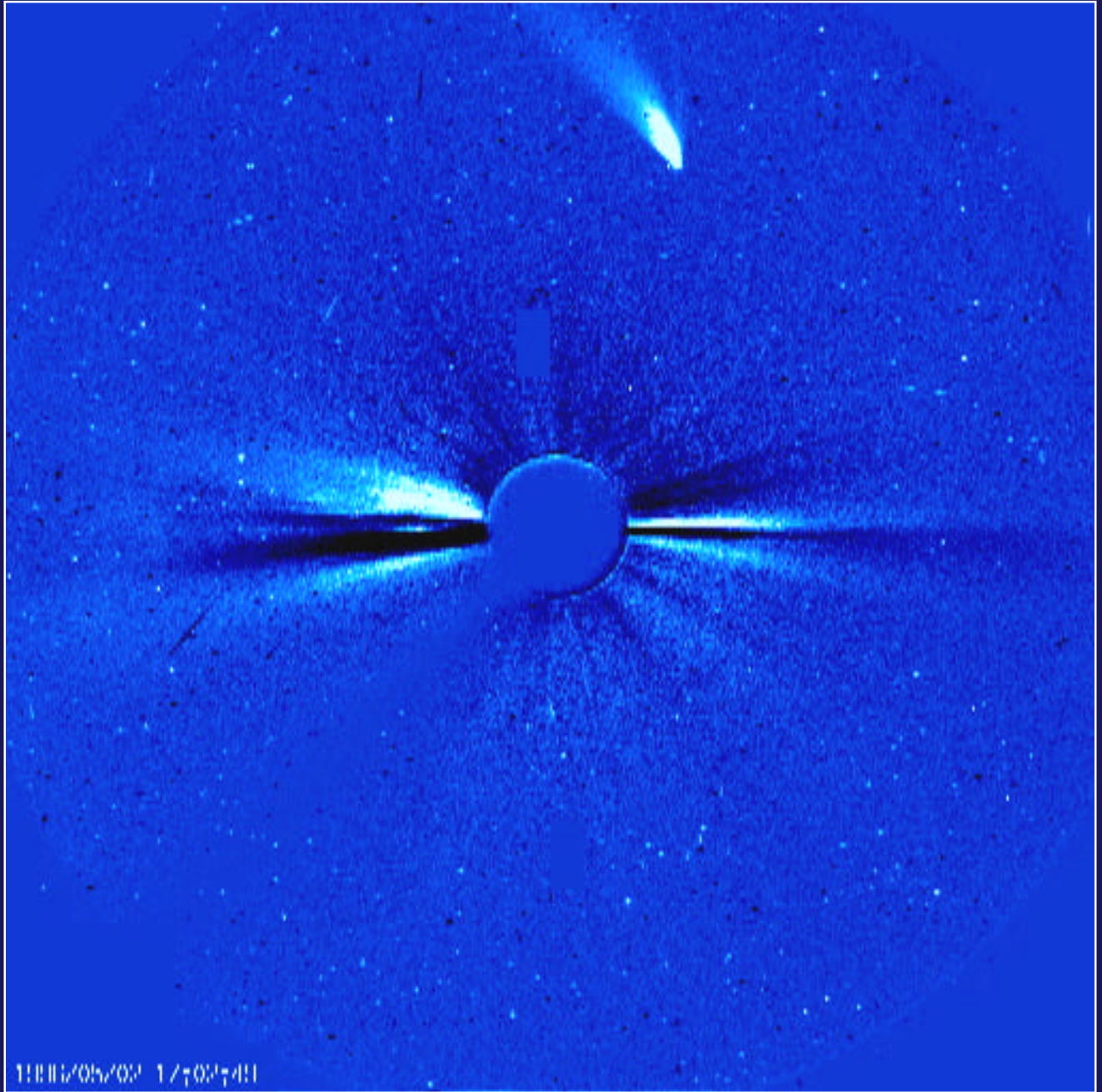
**EIT image sequence of running difference images in Fe XII 195 Å showing a shock wave (caused by a solar flare on 7 April 1997) running across the solar disk.**



**LASCO C1/C2 composite image of the solar corona on 1 February 1996**

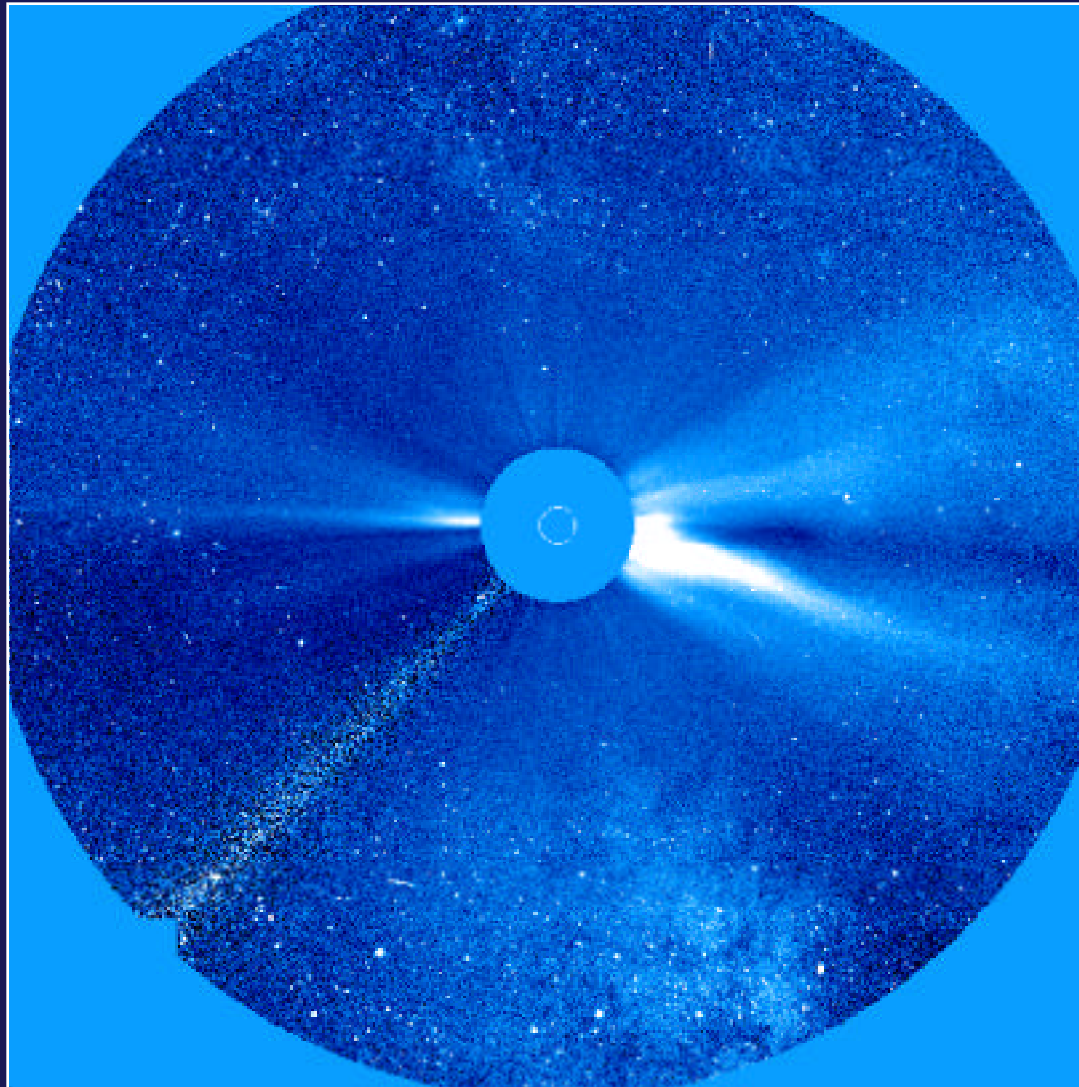
**Inner part: C1 image in the light of the green forbidden coronal line of Fe XIV**

**Outer part: C2 white-light image showing the streamer belt**



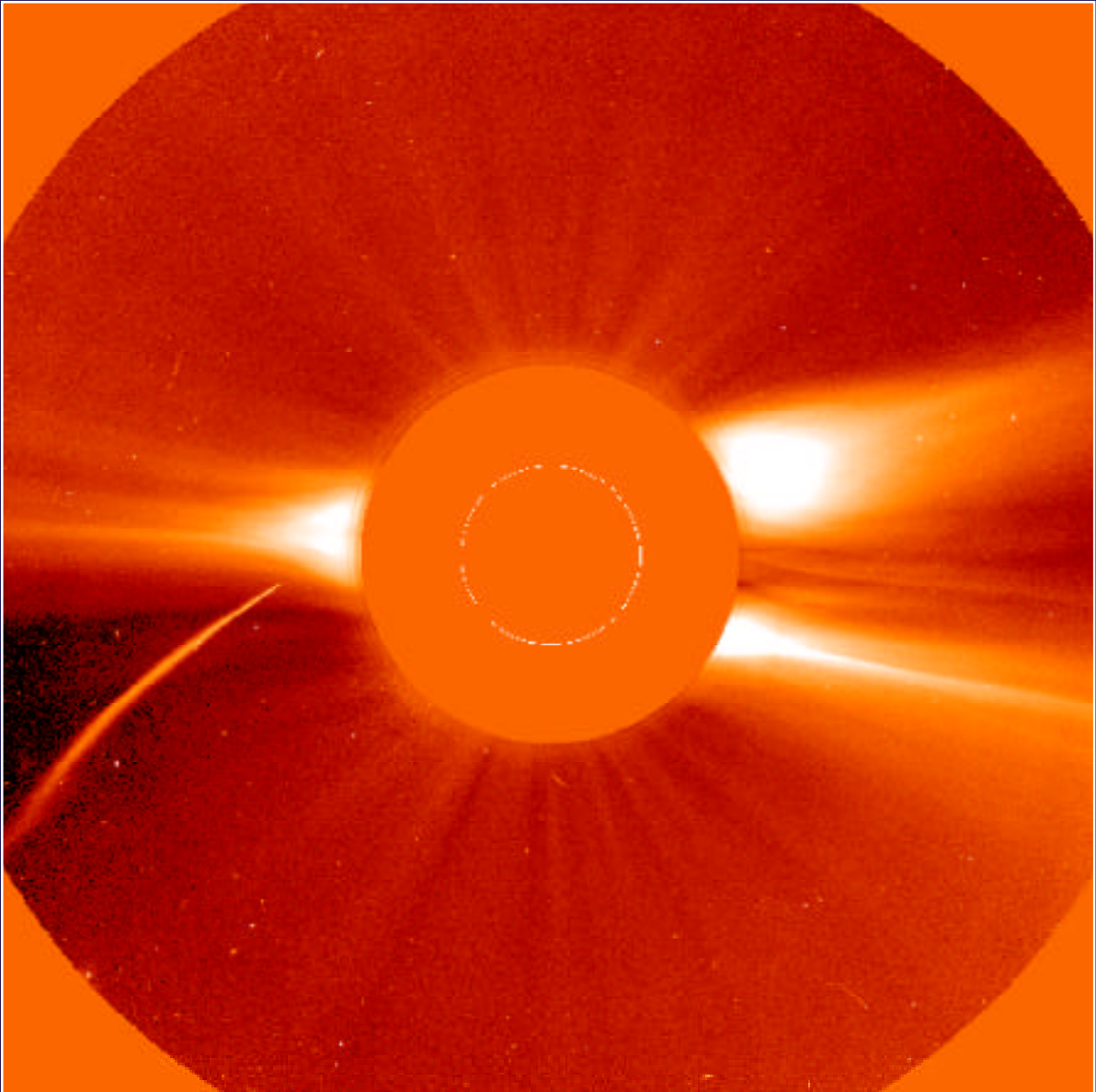
**The Sun's outer corona while Comet Hyakutake is entering the field-of-view of the LASCO C3 coronagraph, 2 May 1996**



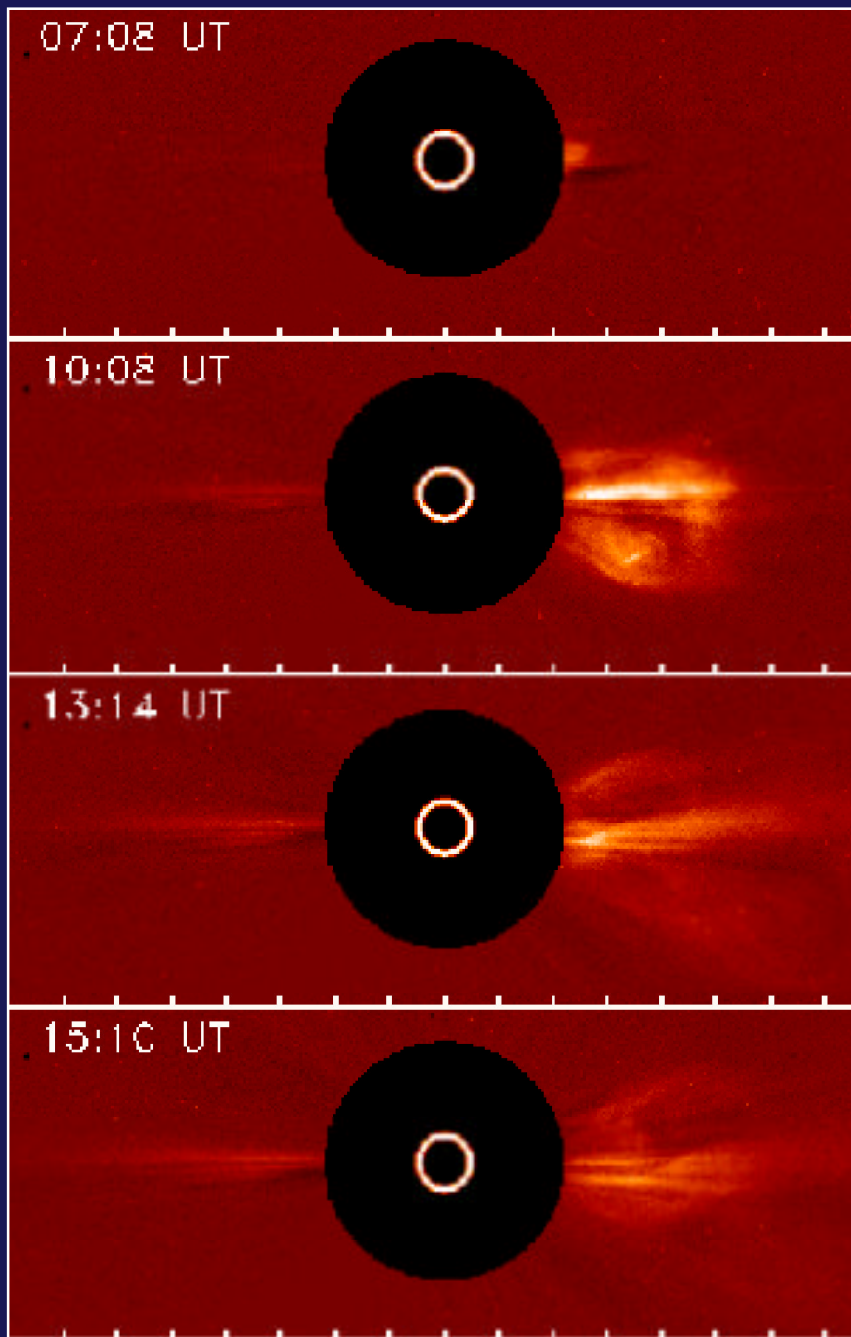


**The extended solar corona in front of the center of the Milky Way as recorded by the LASCO C3 coronagraph on 23 December 1996**

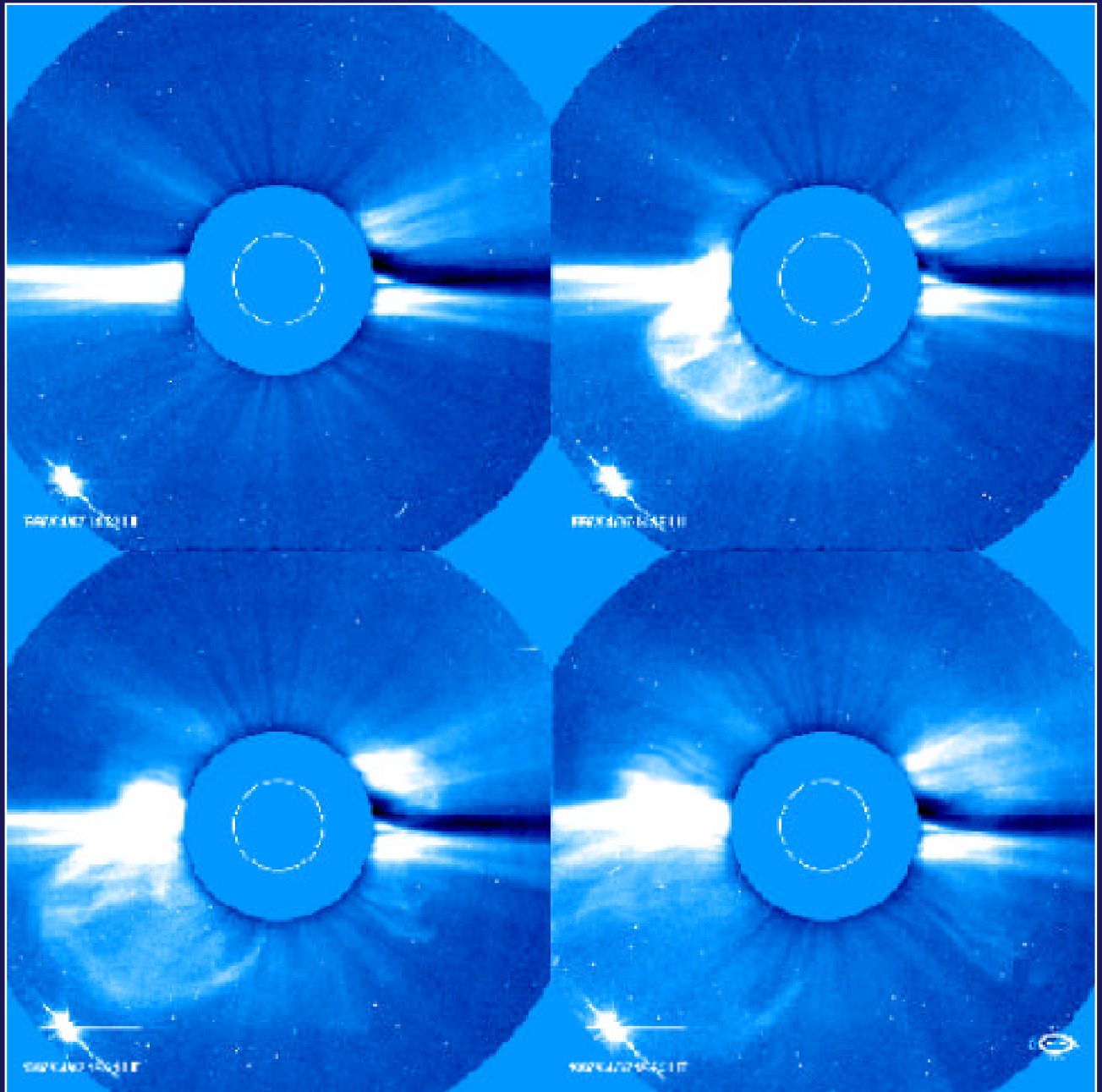




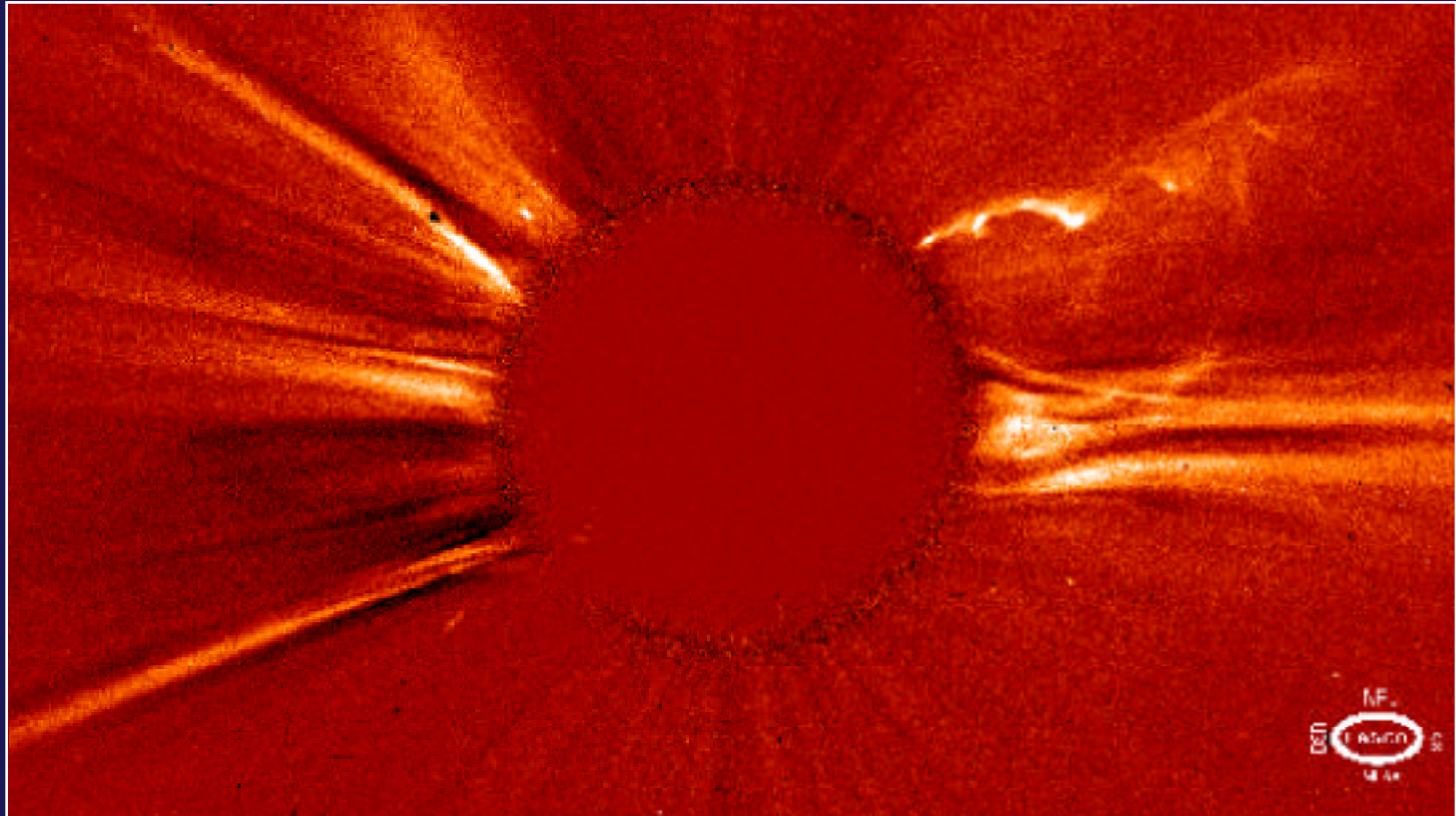
**LASCO C2 image of the solar corona  
on 1996 December 23 showing coronal  
streamers and a sun-grazing comet**



**Large coronal mass ejection (CME)  
as recorded by the LASCO C3  
coronagraph on 15 January 1996**

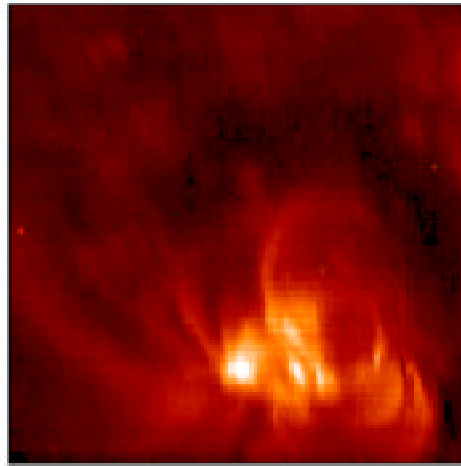


**Image sequence as recorded by the LASCO C2 coronagraph of a “halo” coronal mass ejection on 7 April 1997. Material ejected in this event reached the Earth on April 10-11.**

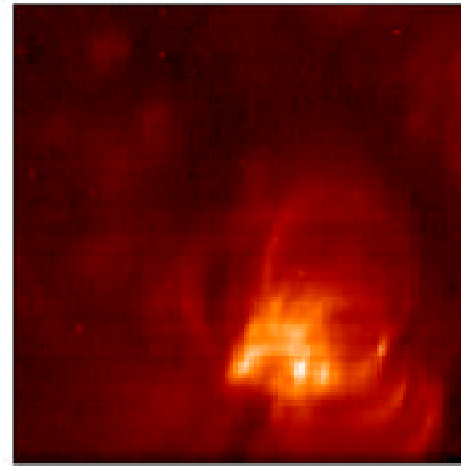


**Coronal streamers and filament eruption as recorded by  
LASCO C2 coronagraph on 21 August 1996**

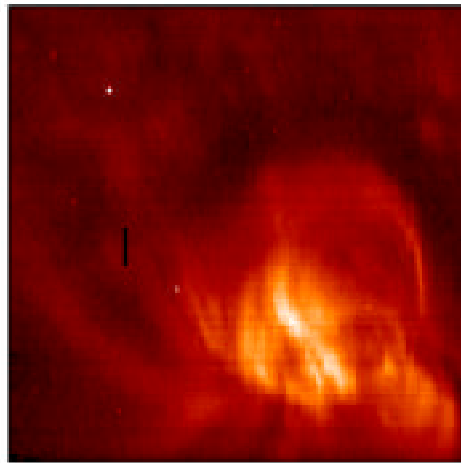




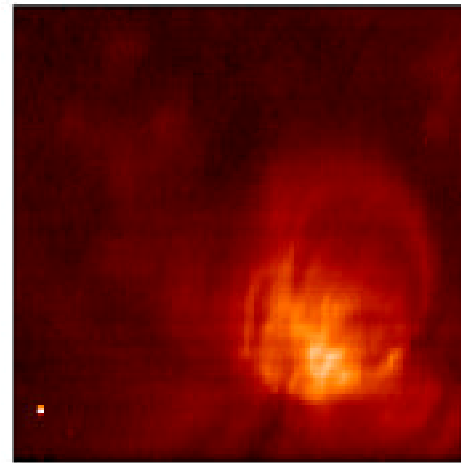
Mg IX 368 A, 12:40 UT



Mg X 625 A, 12:40 UT

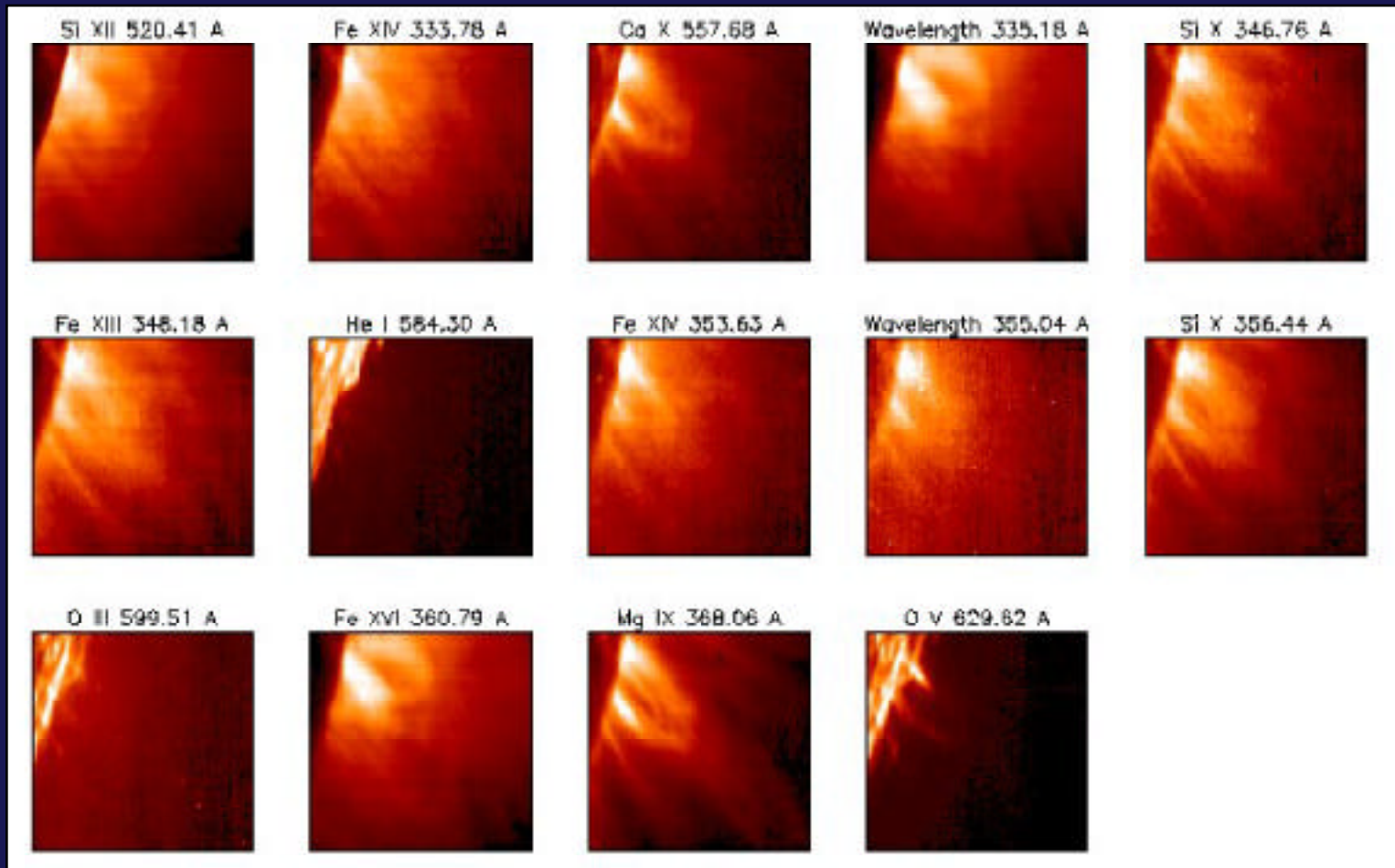


Mg IX 368 A, 13:48 UT



Mg X 625 A, 13:48 UT

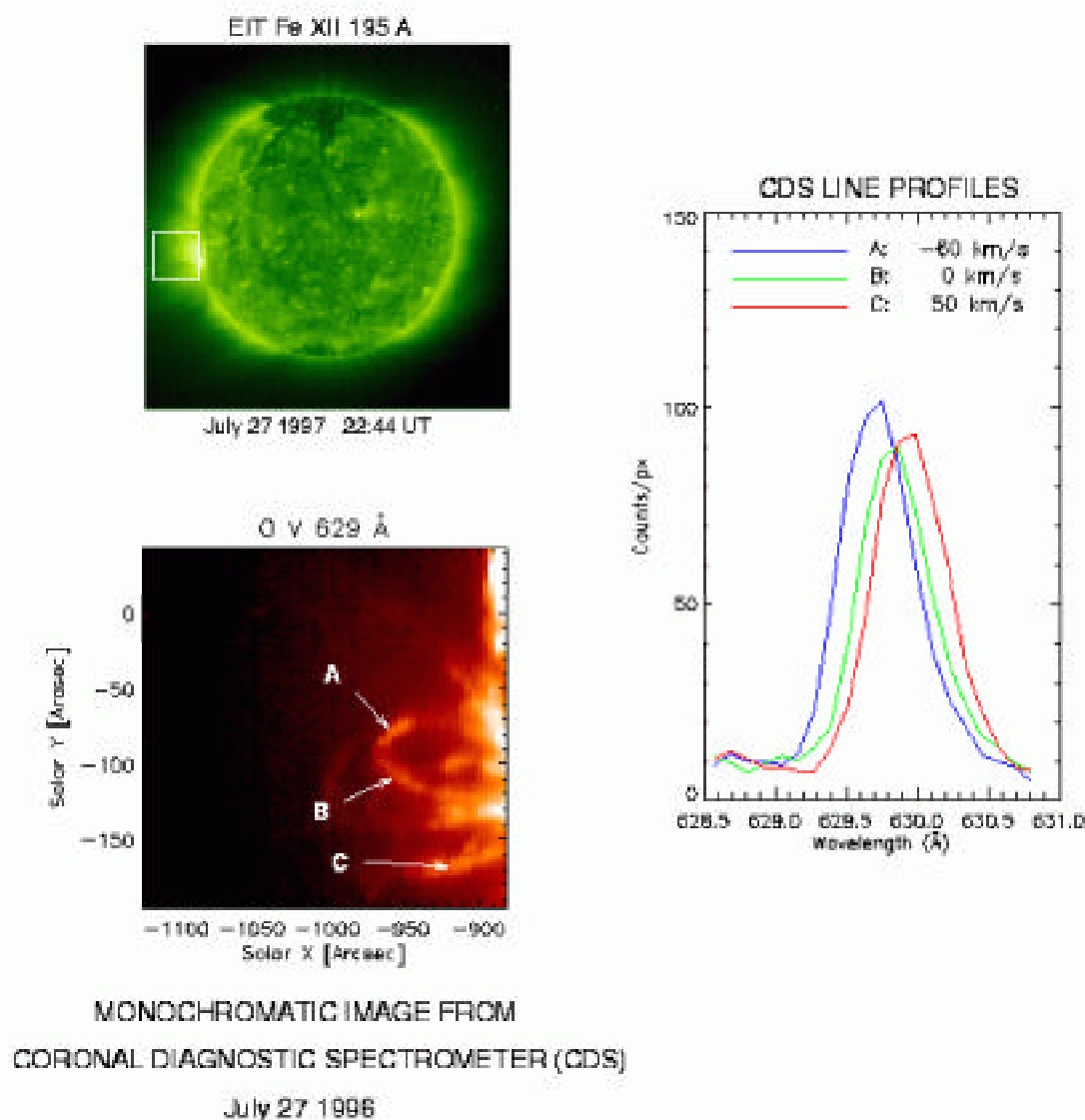
**A developing active region near disk center as recorded by CDS on 22 March 1996**



**Active region on limb as recorded by CDS on 8 September 1996 simultaneously in many emission lines, formed at temperatures from 20,000K to 2 million K**



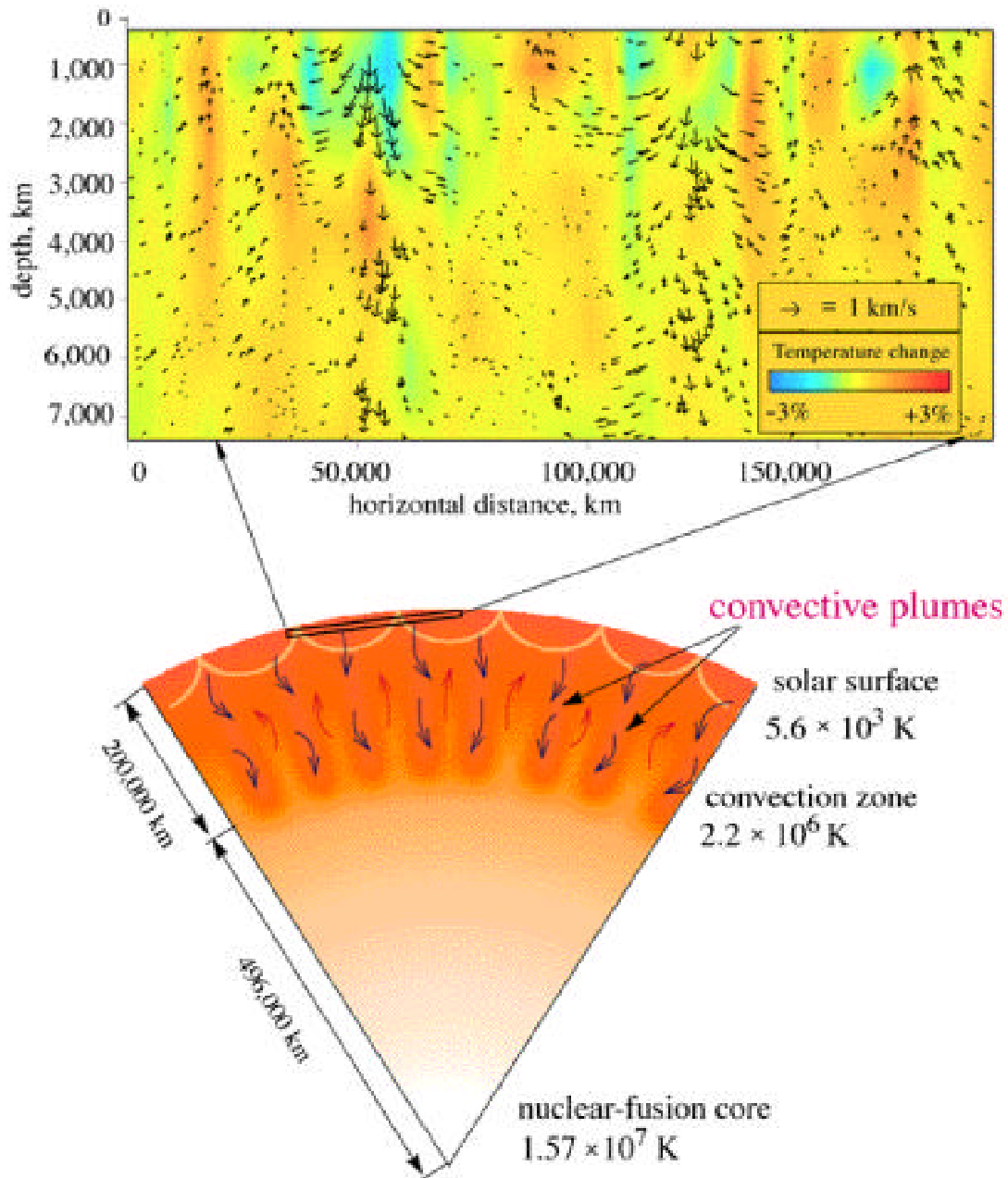
## FLOWS IN AN ACTIVE REGION LOOP SYSTEM



**Active region loop system above the east limb observed in O V on 27 July 1996 by CDS. The line profiles from three different spatial locations (A, B, and C) are displayed in the right panel.**

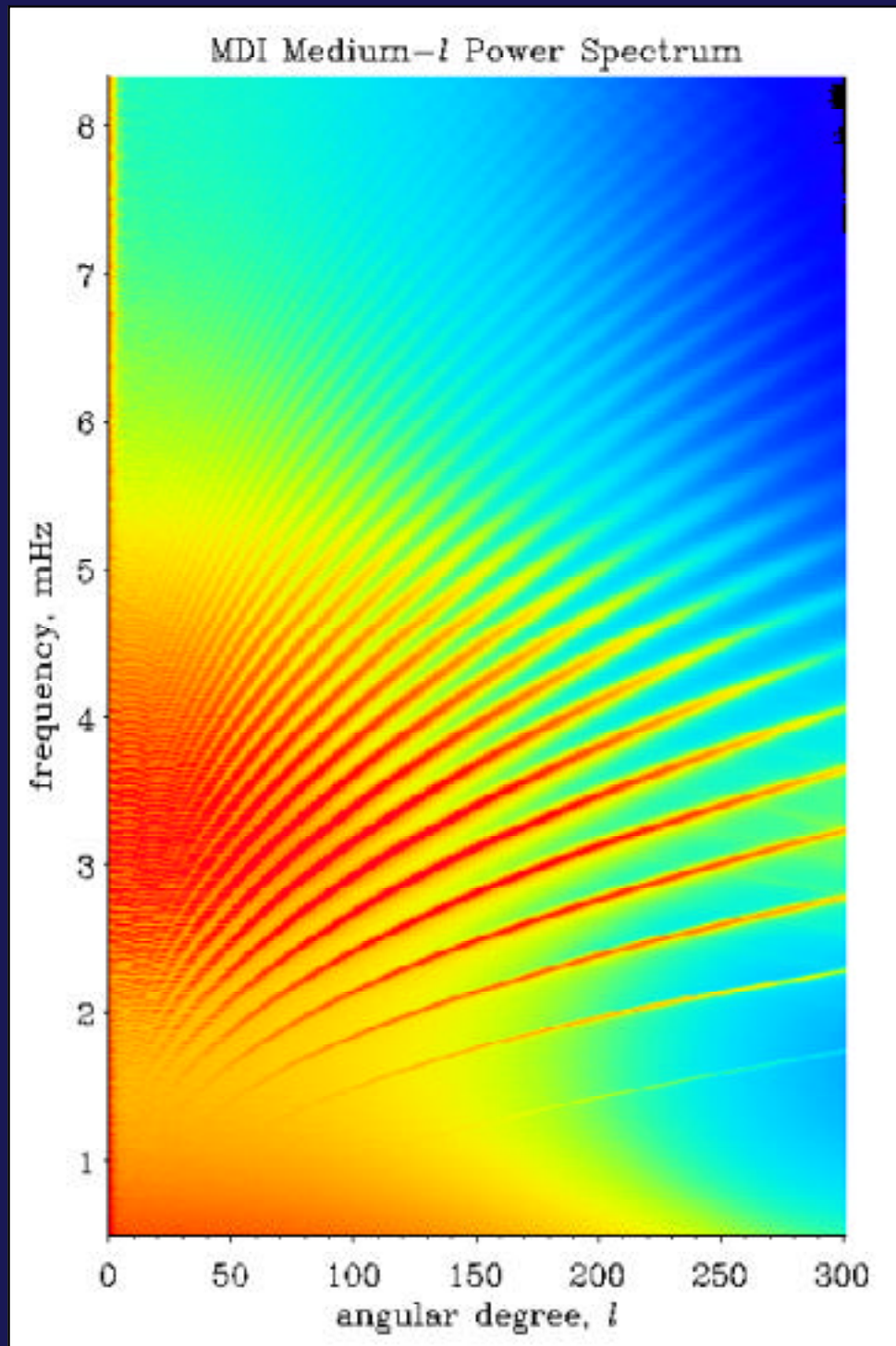


## Convective Flows Below The Sun's Surface

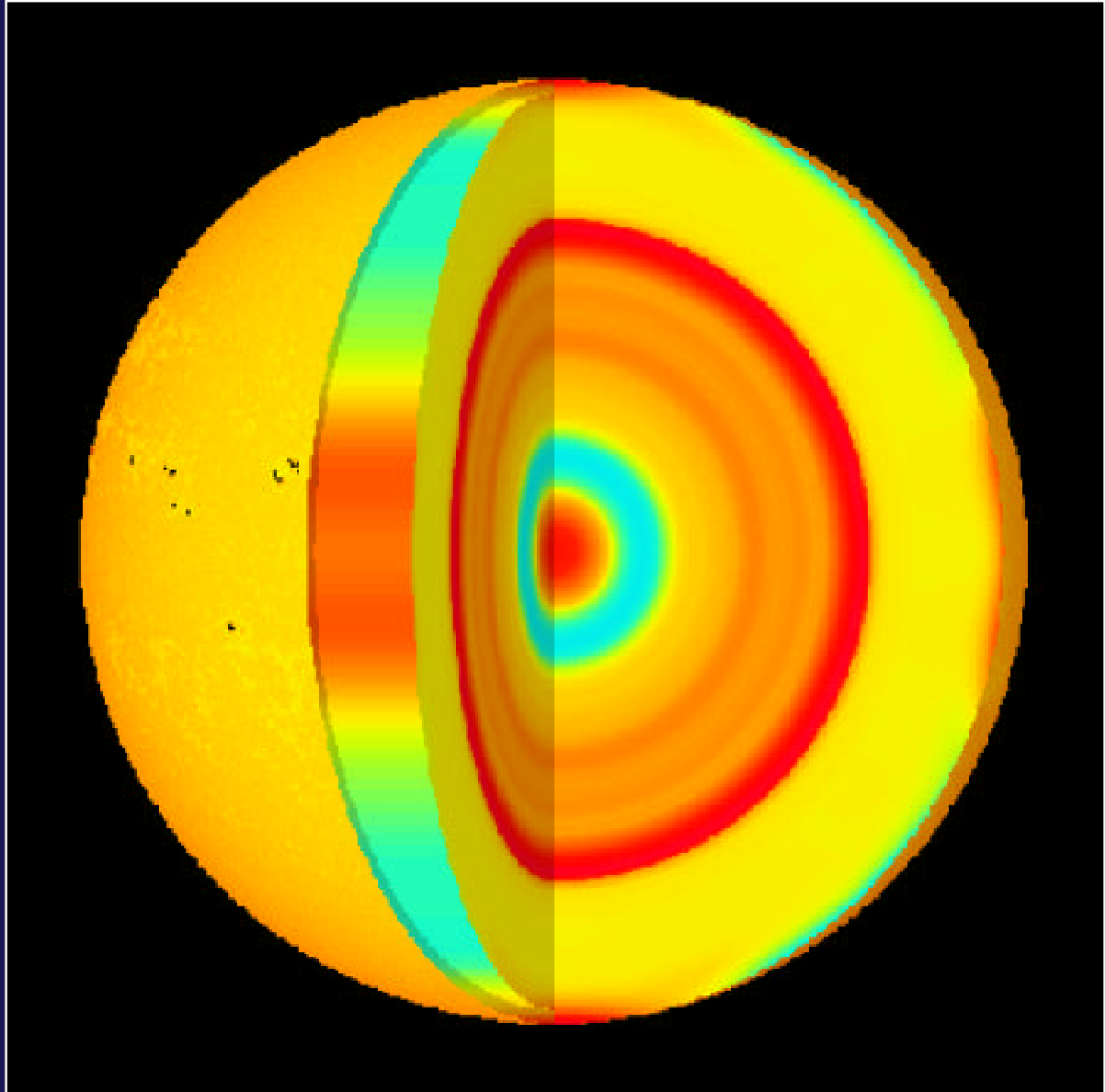


**Subsurface flows  
deduced from MDI observations**

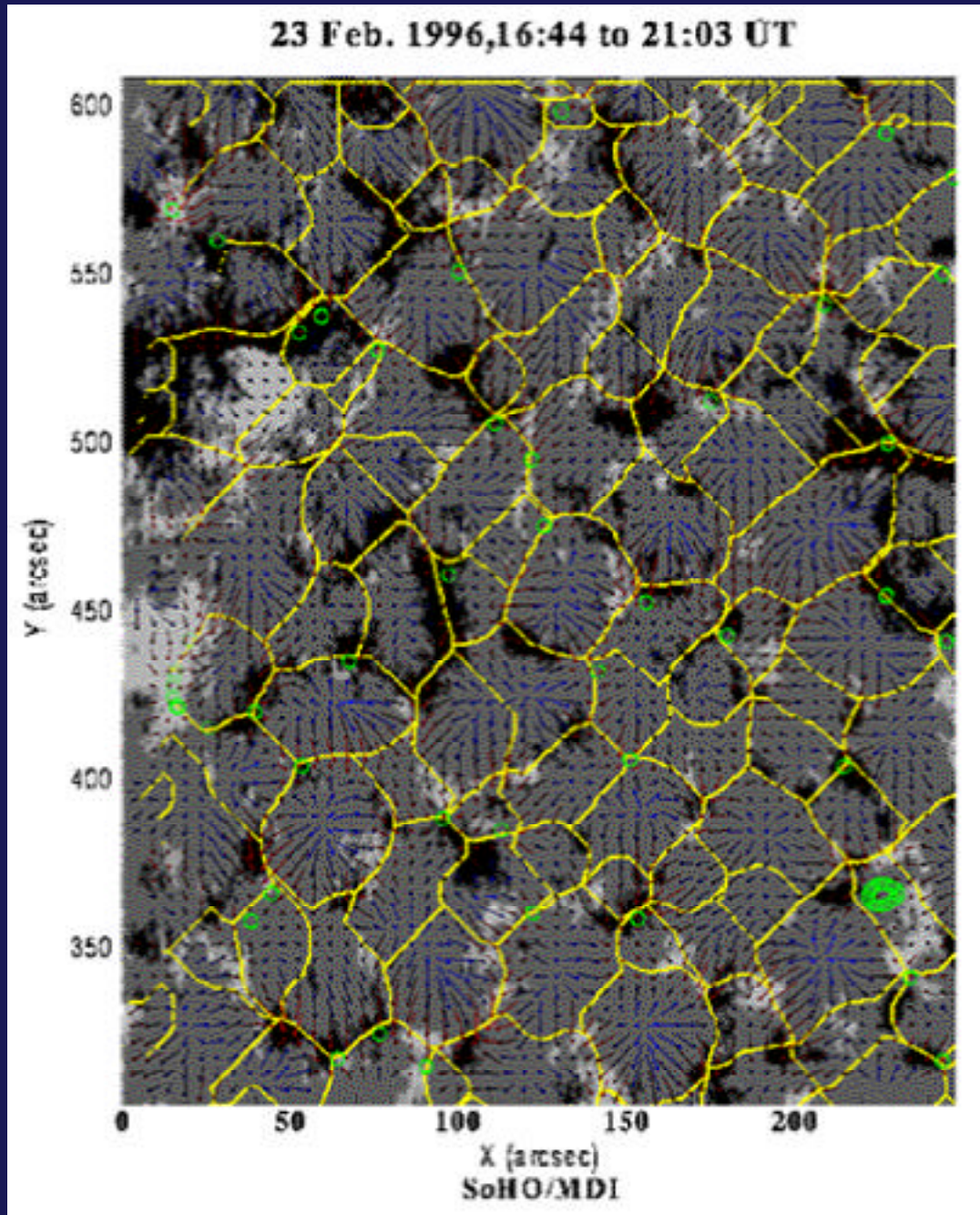




**Power spectrum obtained from 2 months of continuous MDI data (May/June 1996). The "ridges" of greater power result from standing sound waves resonating deep within the Sun.**

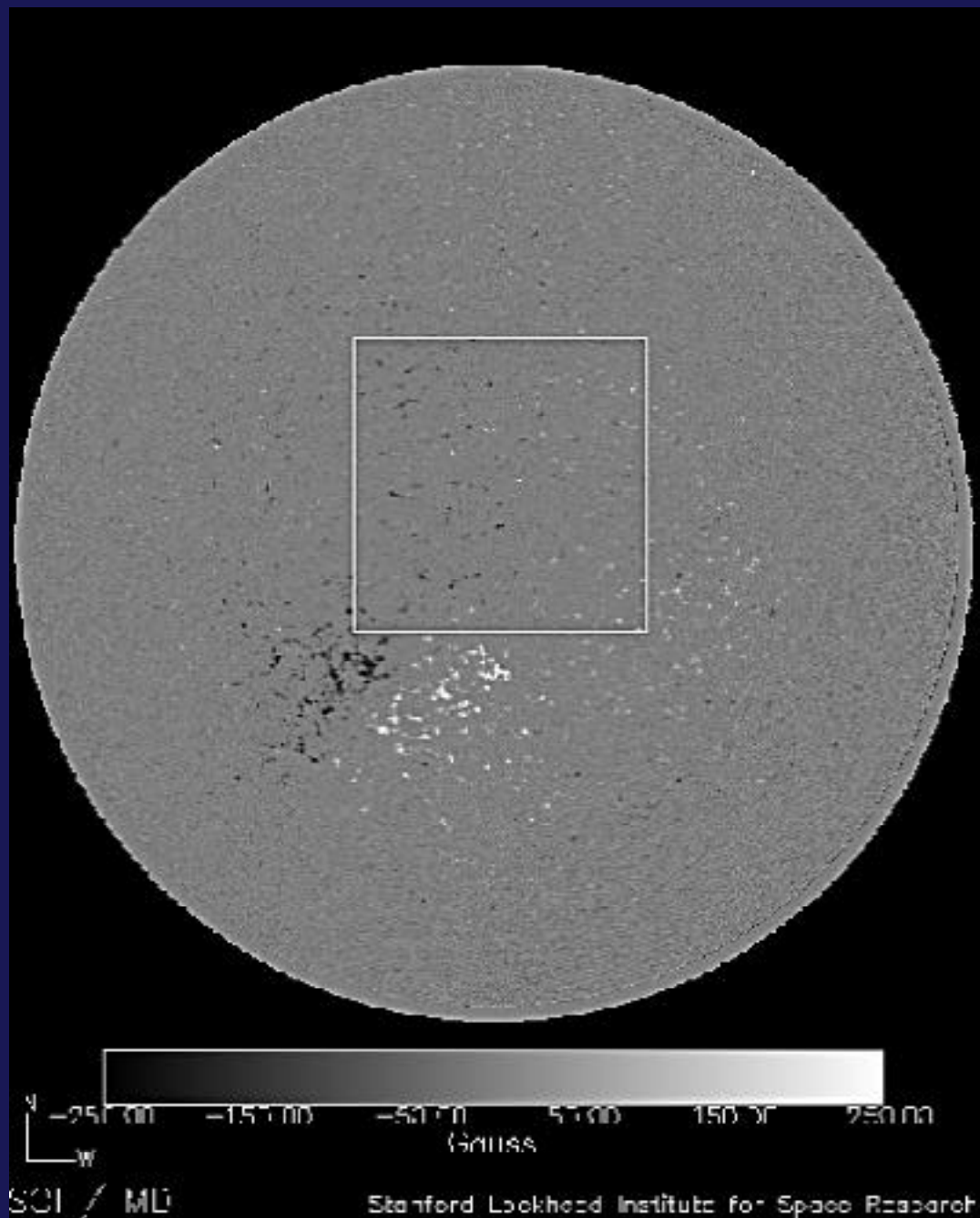


**Radial and latitudinal variations of the sound speed in the Sun as derived from MDI measurements. Red = hotter regions than in standard model, blue = cooler regions.**



**MDI magnetogram overlaid with lines of convergence of the horizontal flow and with green dots showing the convergence points. Measured flow is shown as colored arrows (red= downflow; blue= upflow).**





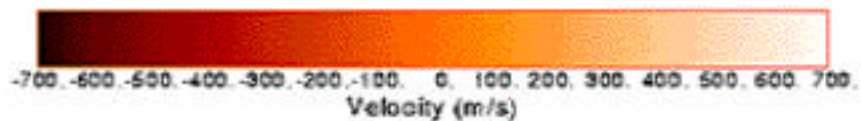
**MDI Full Disk Magnetogram  
25 September 1996**





## Average Dopplergram Minus Polynomial Fit

45 images averaged (30-Mar-96 19:26 to 30-Mar-96 20:17)



SOI / MDI

Stanford Lockheed Institute for Space Research

**MDI Full Disk Dopplergram  
showing superanular convection cells  
on the Sun's surface**



## Single Dopplergram Minus 45 Images Average

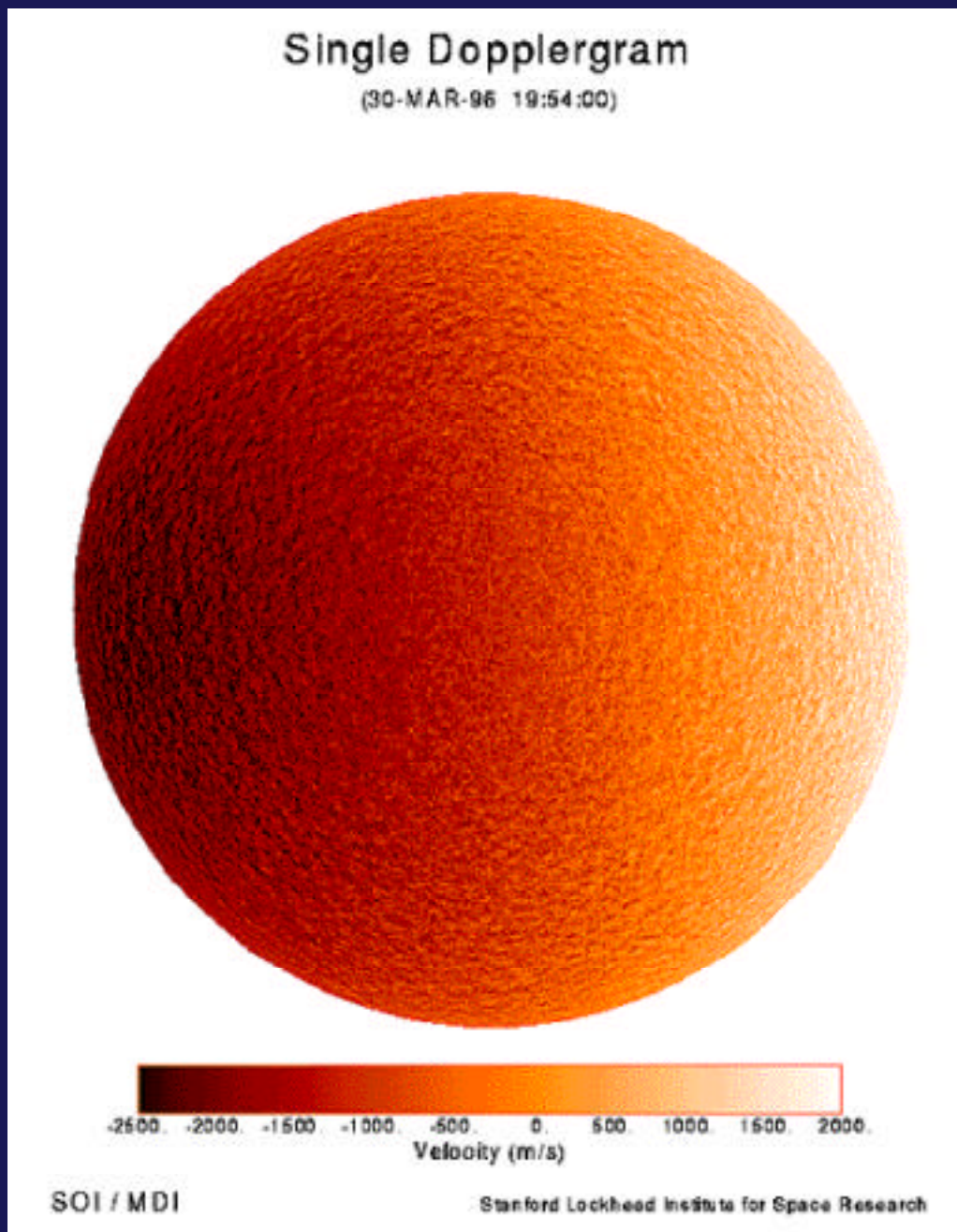
(30-MAR-96 19:54:00)



SOI / MDI

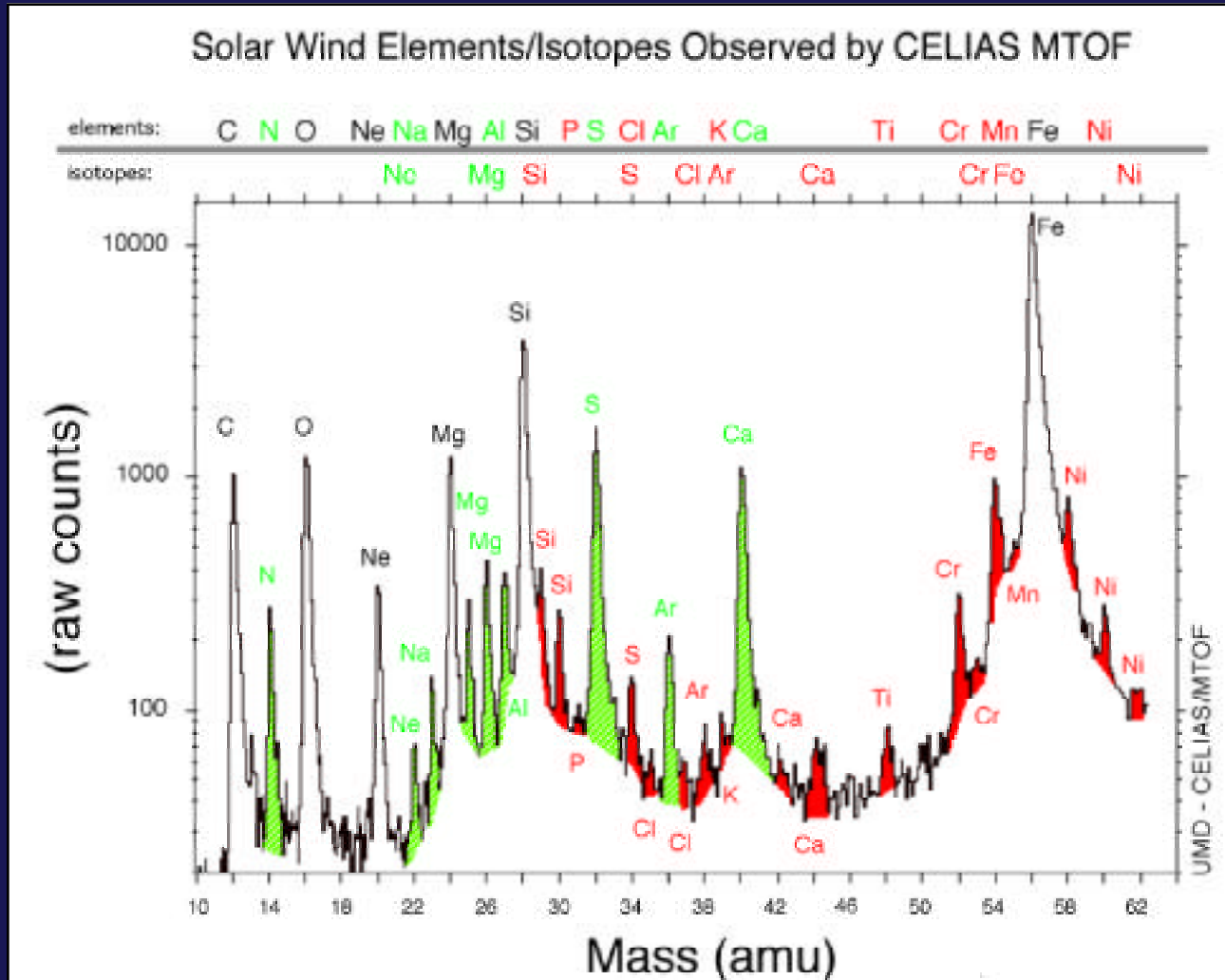
Stanford Lockheed Institute for Space Research

**MDI Full Disk Dopplergram**  
showing the p-mode oscillations of the Sun



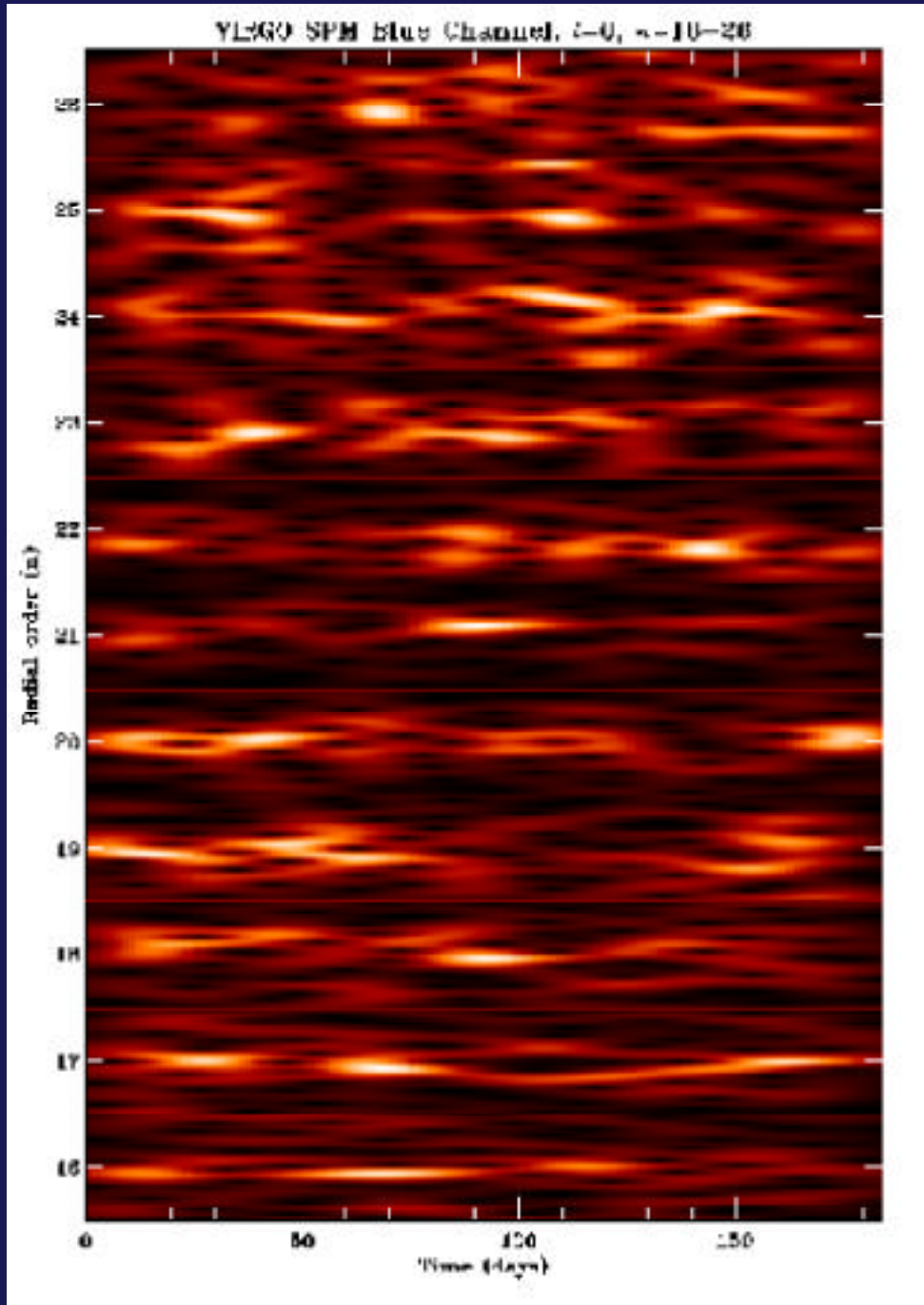
**MDI Full Disk Dopplergram**  
with the dominant feature being the solar rotation  
(dark colors = motion toward the observer)





**CELIAS chart showing new (*red*) and rarely observed (*green*) elements and isotopes discovered in the solar wind**

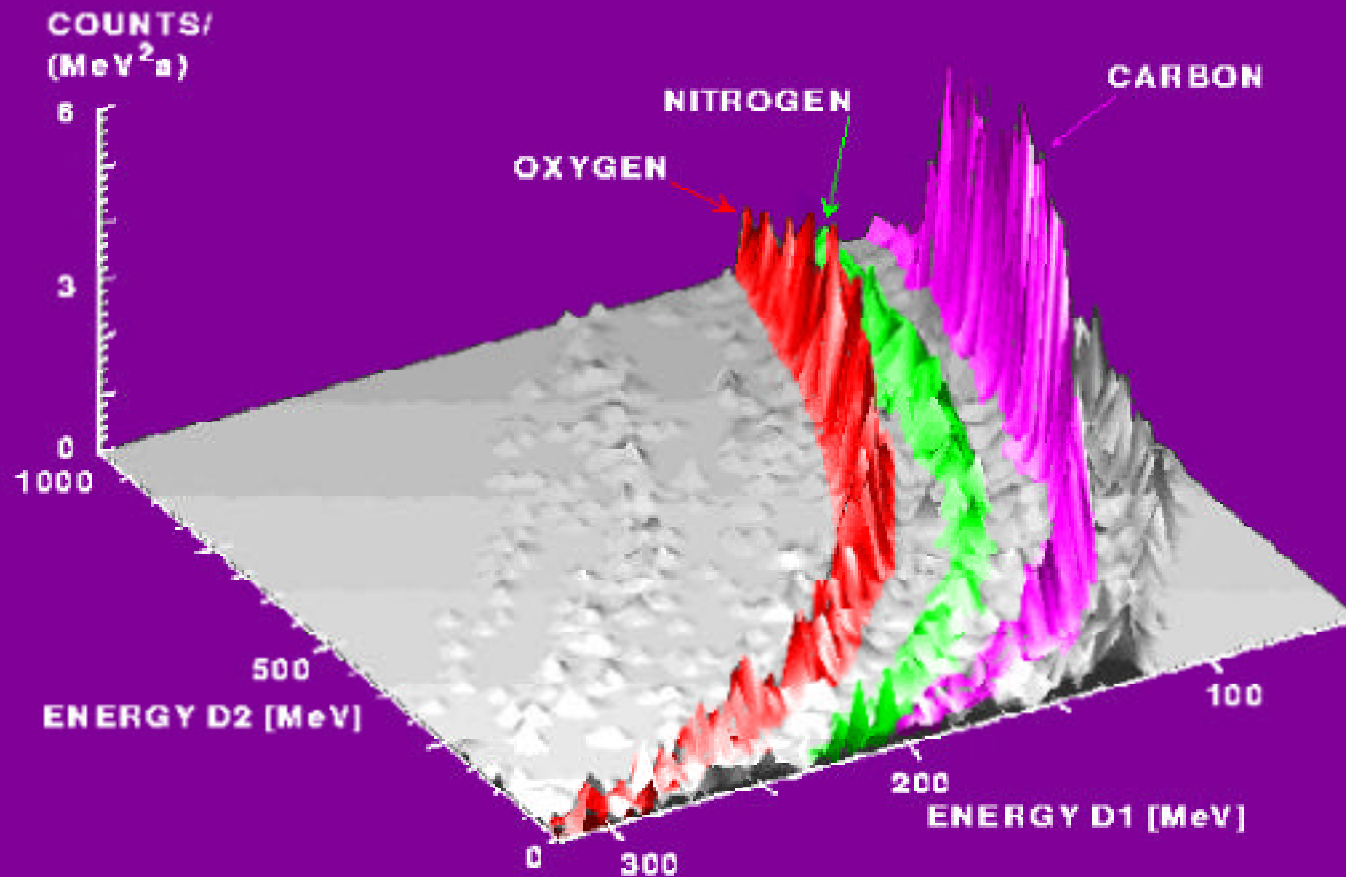




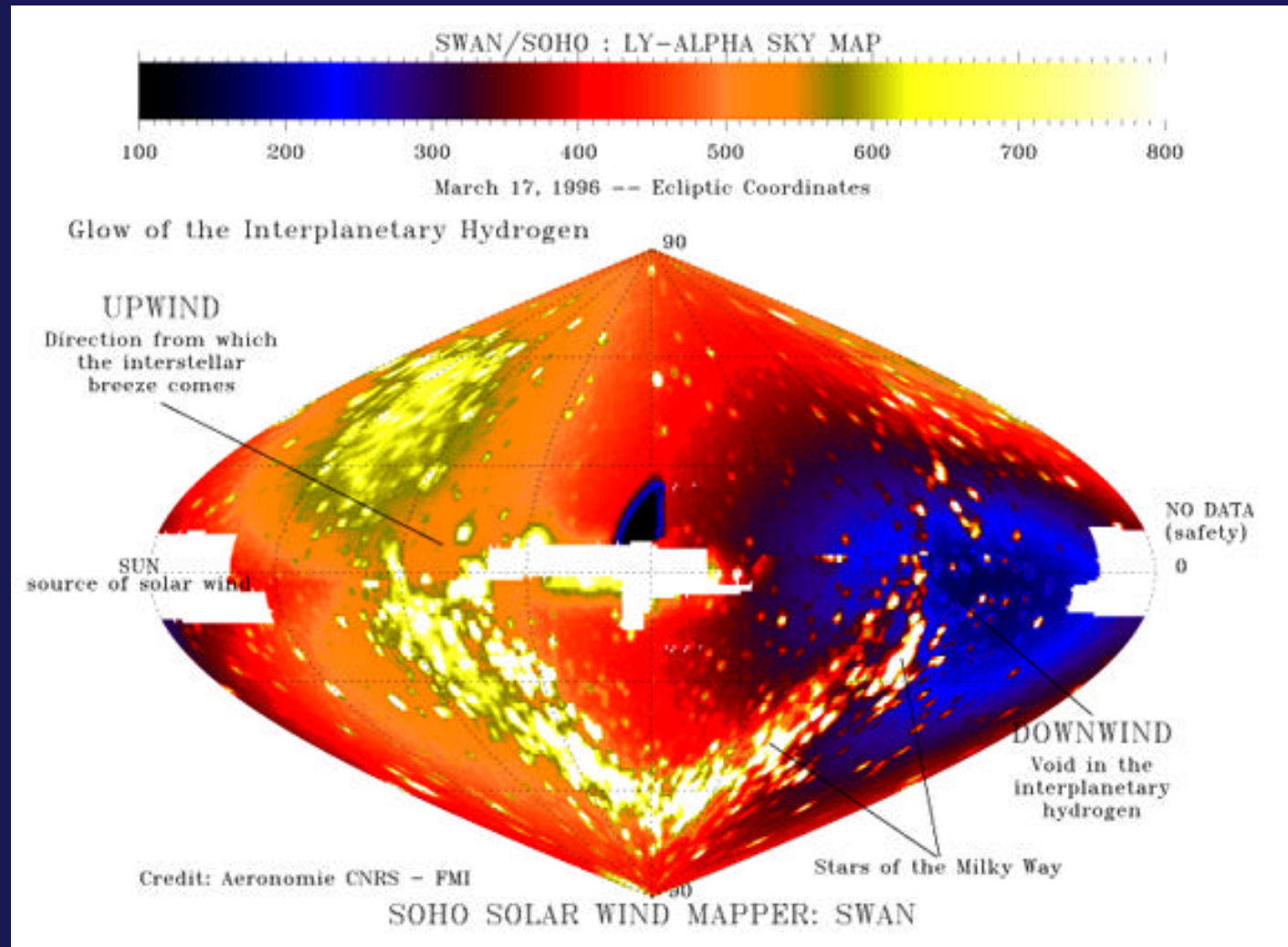
**Temporal variations of the amplitudes of solar p-modes as measured by VIRGO**



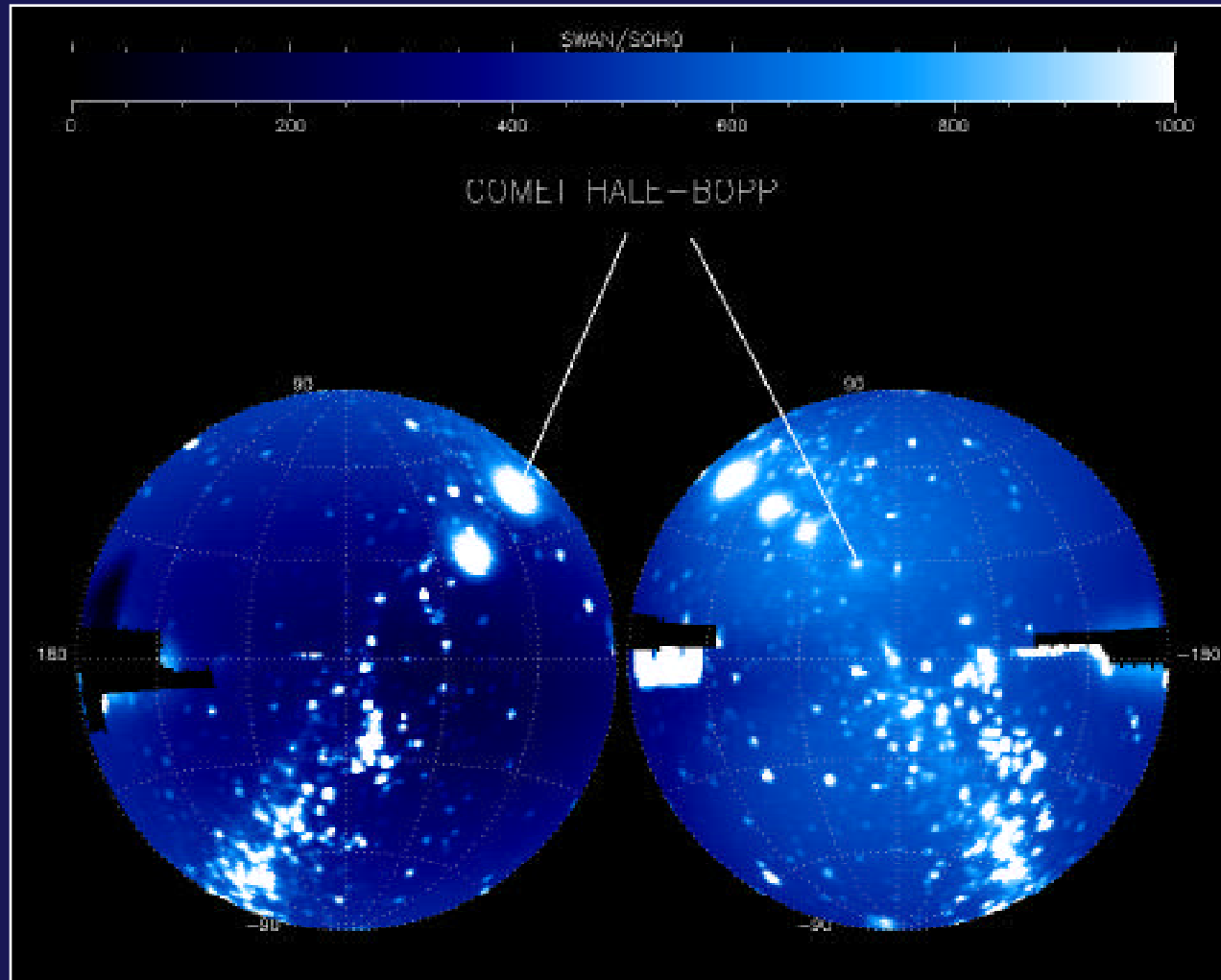
## GALACTIC COSMIC RAYS IN ERNE/HED



Galactic cosmic rays as recorded by ERNE

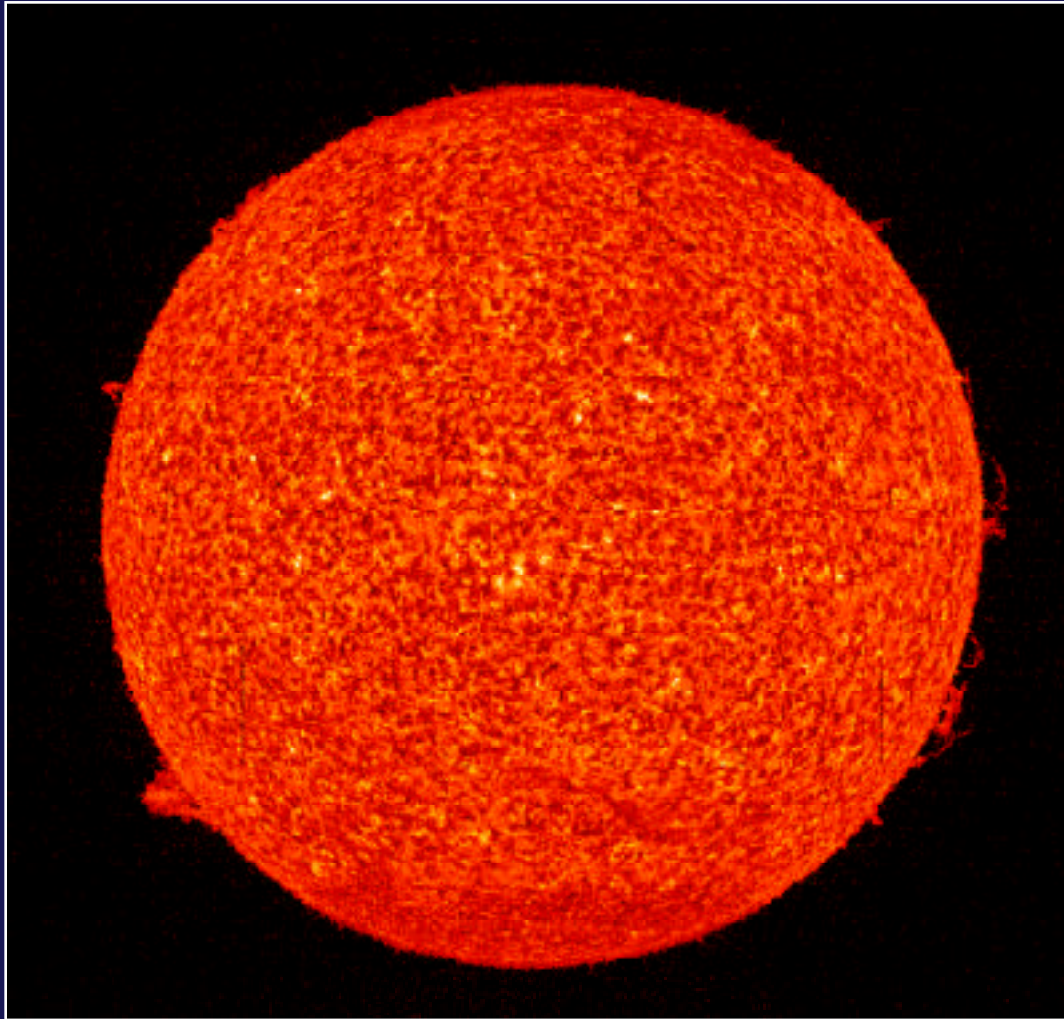


**Lyman- whole sky map as recorded by SWAN on 2 February 1996. The U-shaped yellow, bright band is the Milky Way.**

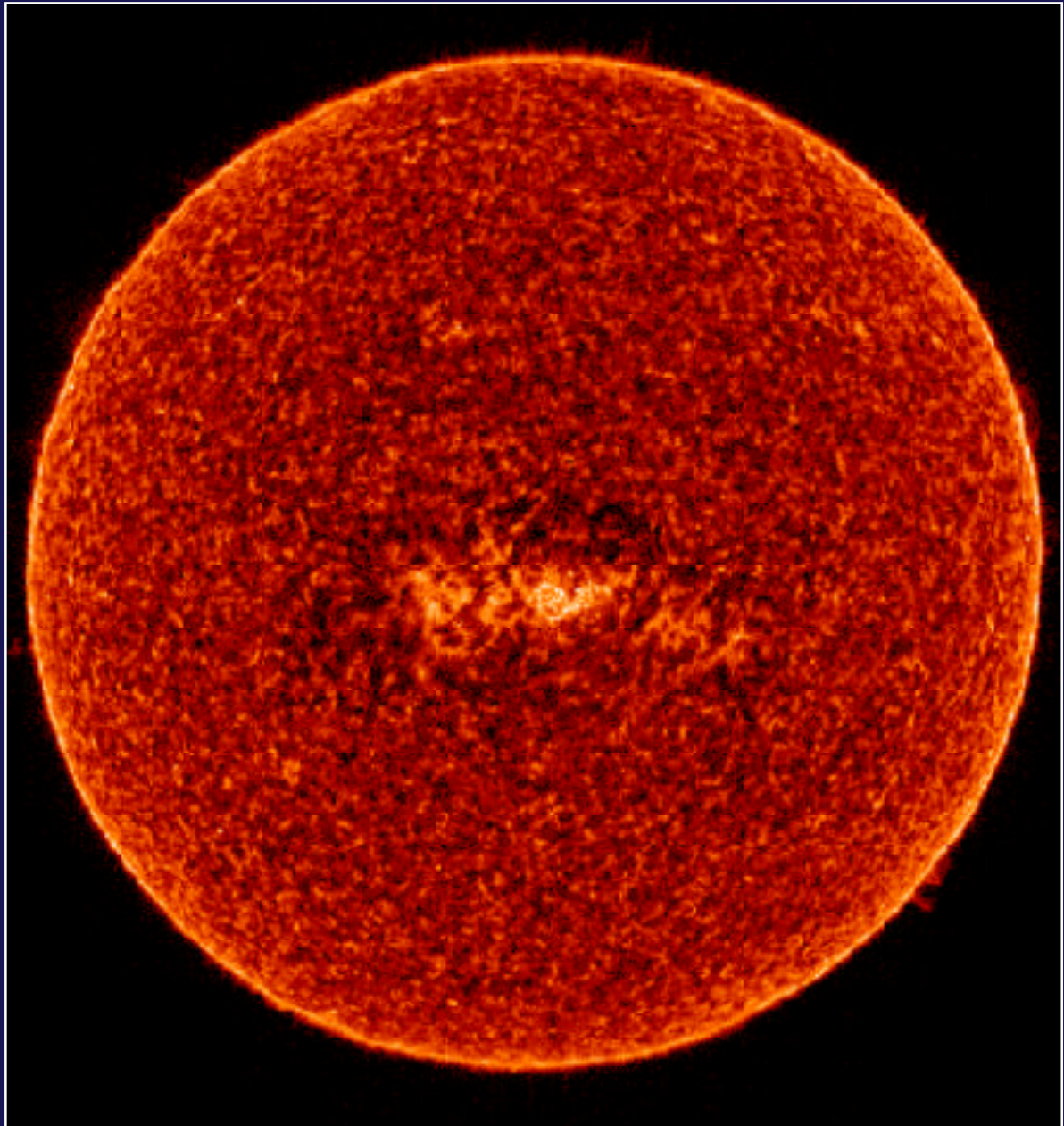


**Comet Hale-Bopp seen approaching the Sun in a time series of six SWAN full sky images in the ultraviolet light (110-180 nm) from 4 January to 3 April 1997.**





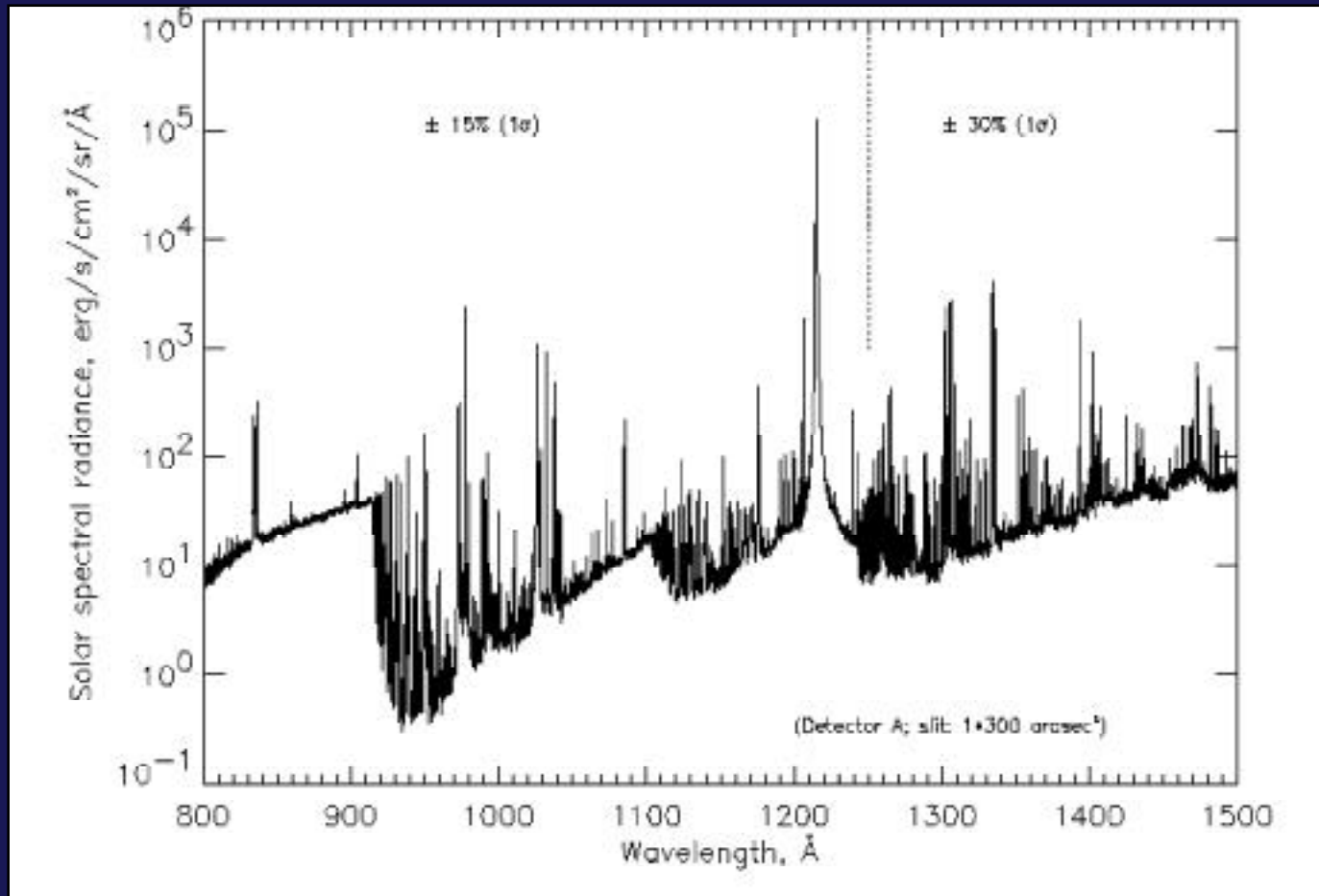
**SUMER image in the emission line of He I at 584.3 Å,  
formed in the upper chromosphere at about 20,000 K  
on 2 - 4 March 1996**



**SUMER image in S VI at 933 Å  
on 1996 May 12**



## SUMER First Order Spectrum of the Quiet Sun

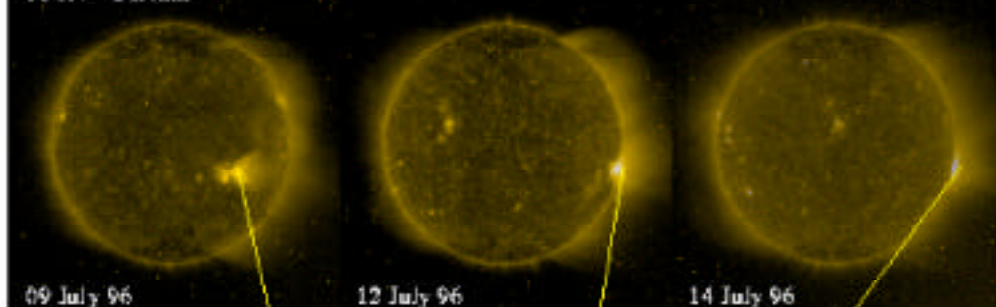


**SUMER EUV Spectrum –  
Spectral atlas in the range 800 - 1500Å**

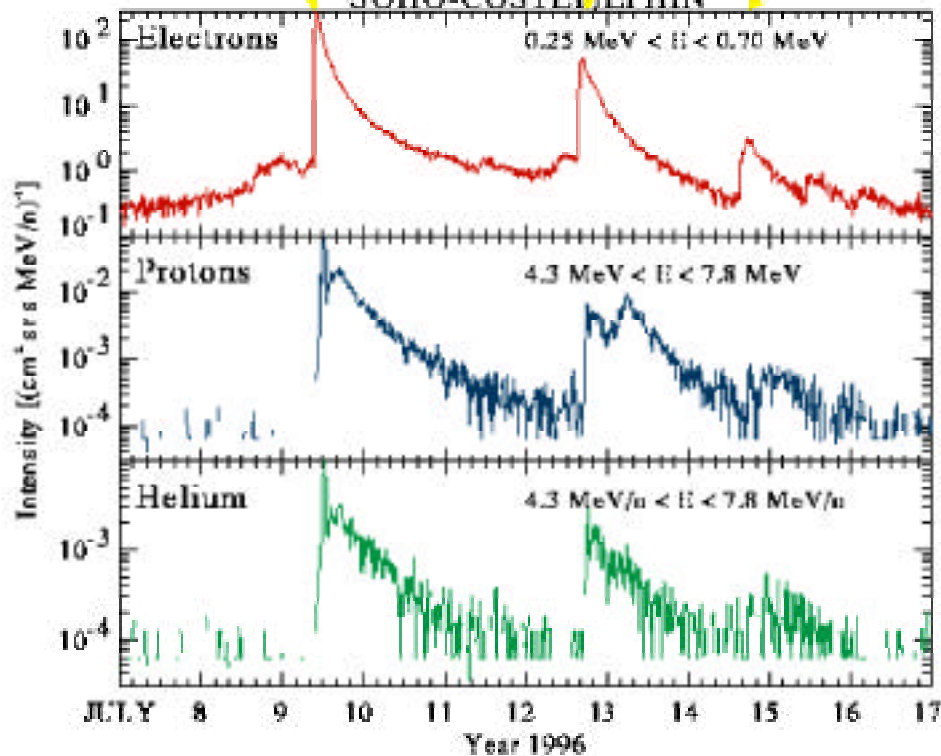


SOHO-EIT

Fe XV 28.4nm



SOHO-COSTEP/EPHIN




**Series of solar energetic particle events observed in July 1996 by the COSTEP instrument**

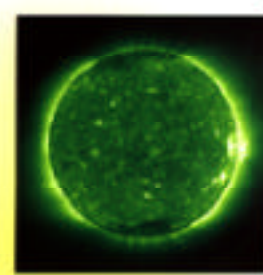




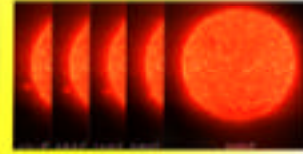
# NEW VIEWS OF THE *SUN*



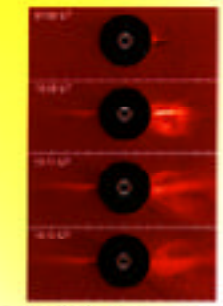
The top portion illustrates the corona, as it appears in our direct line-of-sight, as extremely tenuous gases. This composite image was taken by two instruments aboard the SOHO coronagraph heliosphere observatory spacecraft. The structures in the Sun's atmosphere are controlled by its magnetic field. The composite image also illustrates the corona, where the Sun's magnetic field is visible as it flows away from the base of the corona's surface of the Sun.



An image of the Sun taken in ultraviolet light (see left) is shown here as a composite of images taken by the SOHO coronagraph heliosphere observatory spacecraft. The image shows the Sun's surface as it appears in our direct line-of-sight, as extremely tenuous gases. This composite image was taken by two instruments aboard the SOHO coronagraph heliosphere observatory spacecraft. The structures in the Sun's atmosphere are controlled by its magnetic field. The composite image also illustrates the corona, where the Sun's magnetic field is visible as it flows away from the base of the corona's surface of the Sun.



This sequence of images of the Sun shows it at different ultraviolet wavelengths (from 171 to 282 Angstroms). The images show the Sun's surface as it appears in our direct line-of-sight, as extremely tenuous gases. This composite image was taken by two instruments aboard the SOHO coronagraph heliosphere observatory spacecraft. The structures in the Sun's atmosphere are controlled by its magnetic field. The composite image also illustrates the corona, where the Sun's magnetic field is visible as it flows away from the base of the corona's surface of the Sun.



A series of images of the Sun taken at different ultraviolet wavelengths (from 171 to 282 Angstroms). The images show the Sun's surface as it appears in our direct line-of-sight, as extremely tenuous gases. This composite image was taken by two instruments aboard the SOHO coronagraph heliosphere observatory spacecraft. The structures in the Sun's atmosphere are controlled by its magnetic field. The composite image also illustrates the corona, where the Sun's magnetic field is visible as it flows away from the base of the corona's surface of the Sun.

SOHO educational poster (high school level) with images and explanatory text on the back side

For additional information and images, an excellent resource is the SOHO homepage at <http://sohowww.nascom.nasa.gov/>

